American Wood Preservers' Association

1915

PROCEEDINGS

OF THE

Eleventh Annual Meeting

OF THE

AMERICAN WOOD PRESERVERS' ASSOCIATION

HELD AT

CONGRESS HOTEL AND ANNEX, CHICAGO, ILL.

JANUARY 19, 20 and 21, 1915

F. J. ANGIER, Secretary-Treasurer

Baltimore, Maryland

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J. H. WATERMAN
President, 1915

AMERICAN WOOD PRESERVERS' ASSOCIATION

Constitution and By-Laws

(Adopted January 17, 1905.)
(Amended January 18, 1912.)
(Amended January 21, 1915.)

ARTICLE I.

Name and Objects.

SECTION 1. The name of this Association shall be "American Wood Preservers' Association."

SEC. 2. The objects and purposes of the Association shall be to advance the wood-preserving industry in all its branches; to afford its members opportunities for the interchange of ideas with respect to improvements in the wood-preserving industry, and for the discussion of all matters bearing upon the industry of wood-preserving; to maintain a high business and professional standard in all respects, and to standardize specifications for wood preservatives and their introduction into the materials to be preserved.

SEC. 3. The means to be employed for these purposes shall be meetings for the presentation and discussion of appropriate papers, and for social and professional intercourse; the publication of such papers and discussion as may be deemed expedient; co-operation with other societies, associations and organizations in the work of standardizing specifications affecting the wood-preserving industry, and all other things incidental or conducive to the attainment of the objects of the Asociation or any of them, and as the members from time to time consider advisable.

ARTICLE II.

Membership.

SECTION 1. The Association shall consist of Corporate, Associate, Junior and Honorary members.

SEC. 2. A Corporate member shall be either an Executive or Administrative officer, or one directly connected with the operation of a wood-preserving plant or Forestry Bureau, including Plant Superintendents, Assistant Plant Superintendents, Treating Foremen and Plant Chemists.

Men in the following positions will also be eligible for Corporate membership: City Engineers, Professors and Instructors in Institutions of Learning, Railroad, Consulting, Forestry, County, Highway, Contracting and Inspecting Engineers, Engineers of Tests and City Chemists.

SEC. 3. An Associate member shall be any person interested in the sale of material or equipment used in the wood-preserving industry.

SEC. 4. A Junior member shall be any person who may not qualify as a Corporate or Associate member.

SEC. 5. Honorary members shall be chosen from persons of acknowledged eminence in some branch of the wood-preserving industry or the sciences relating thereto. Honorary members shall be proposed by at least ten members, none of whom shall be a member of the Executive Committee, and shall be elected by a unanimous vote of the Executive Committee, or by election at any annual convention, or by letter ballot; provided that if elected at any annual convention a two-thirds vote of the Corporate and Honorary members present, there being at least fifty per cent. of the total Corporate and Honorary membership present and voting, be necessary; if elected by letter ballot a two-thirds vote of the total Corporate and Honorary membership be necessary.

SEC. 6. Corporate members shall be entitled to all of the privileges of the Association.

SEC. 7. Associate and Junior members shall enjoy all the privileges of the Association, except that they shall not be entitled to vote or hold office.

SEC. 8. Honorary members shall be entitled to all the privileges of a Corporate member.

ARTICLE III.

Admission.

SECTION 1. Application for admission to the Association shall be in the form prescribed by the Executive Committee, endorsed by one Corporate or Honorary member of the Association, and forwarded to the Secretary-Treasurer for transmission to the Chairman of the Executive Committee.

SEC. 2. The Executive Committee, by a majority vote, shall pass upon said application by letter or by personal ballot, and if said applicant is duly elected a member instruct the Secretary-Treasurer to so inform him by forwarding to him a certificate of membership bearing the date of his election and to enter his name upon the rolls of the Association.

SEC. 3. In the case of favorable action, upon the applicant forwarding to the Secretary-Treasurer the proper amount of dues for the current year, the Secretary-Treasurer shall forward to such member-elect a certificate of membership bearing the date of his election by the Executive Committee. Should such applicant fail to pay the membership fee for a period of thirty days after the date of notification

of his election by the Secretary-Treasurer the same shall lapse, unless, in the opinion of the Executive Committee, the circumstances warrant an extension of time for an additional period of thirty days.

ARTICLE IV.

Initiation Fees and Dues.

SECTION 1. The entrance fees payable on admission to the Association shall be as follows: Corporate members, $10.00; Associate members, $15.00; Junior members, $5.00.

SEC. 2. The annual dues payable by members, whether Corporate or Associate, shall be $10.00. Junior members shall pay annual dues of $3.00, the initiation fee to cover the first year's dues.

SEC. 3. The annual contribution shall become due for the ensuing year on the first of January and shall be payable in advance. It shall be the duty of the Secretary-Treasurer to notify each member of the amount due for the ensuing year at the time of giving notice of the annual meeting.

SEC. 4. Persons elected after six (6) months of any fiscal year shall have expired shall pay only one-half (½) of the amount of dues for that fiscal year.

SEC. 5. Any person whose dues are in arrears more than three months shall be notified by the Secretary-Treasurer and until same are paid his privilege of membership shall be in abeyance. Should his dues become one year in arrears his membership in the Association shall be cancelled, and the Proceedings shall be withheld until dues are paid to date.

ARTICLE V.

Officers.

SECTION 1. The officers of the Association shall be a President, three Vice-Presidents, a Secretary-Treasurer and six other members to be elected to make up an Executive Committee of eleven, this Committee to have entire jurisdiction over the affairs of the Association, to appoint the Committees, to have entire responsibility for the government of the Association, to pass upon the eligibility of proposed members, to arrange programs for meetings, to select subjects for discussion and to have full power in all matters not otherwise provided for.

SEC. 2. No two or more officers of this Association in any one year shall be either officers or emloyees of the same company or corporation.

SEC. 3. The terms of the President, Vice-Presidents and Secretary-Treasurer shall begin at the close of the annual meeting at

which such officers are elected and shall continue for a term of one year. The six other members constituting the Executive Committee shall be elected for terms of three years, two members being elected each year. Five members of the Executive Committee shall constitute a quorum.

SEC. 4. A vacancy in the office of President shall be filled by the Vice-Presidents in proper order.

SEC. 5. All officers shall be elected by ballot.

SEC. 6. The President and Vice-Presidents shall not be eligible for re-election to the same office until at least one full term shall have elapsed after the end of their respective terms.

ARTICLE VI.

Management.

SECTION 1. The President shall have a general supervision of the affairs of the Association. He shall preside at the meetings of the Association and of the Executive Committee at which he may be present and shall be ex-officio member of all committees. He shall deliver an address at the annual convention. The Vice-Presidents in order of their seniority, shall preside at the meetings in the absence of the President and discharge his duties in case of a vacancy in the office.

SEC. 2. The Executive Committee shall manage the affairs of the Association in conformity with the provisions of this Constitution. They shall direct the investment and care of the funds of the Association; make appropriations for specific purposes; act upon applications for membership, as heretofore provided; constitute the Auditing Board, and generally conduct the business of the Association. They shall make an annual report at the annual meeting, transmitting the report of the Treasurer and of other officers and committees.

SEC. 3. The Secretary-Treasurer, under the direction of the President and Executive Committee, shall be executive officer of the Association, having charge of the books of the Association, and keeping a record of all meetings, and of other matters, as directed by the President or the Executive Committee. It shall also be his duty to advise the members of all meetings, taking charge of and preserving all papers read and discussed, and when necessary, preparing copies or abstracts of the same for publication. He shall also see that all moneys due the Association are collected and be the custodian thereof. He shall verify the correctness of all bills presented for payment and pay the same when duly approved and countersigned by the President. He shall also make an annual report, to be audited and presented to the Association by the Executive Committee.

ARTICLE VII.

Meetings.

SECTION 1. An annual meeting at which the officers for the ensuing year shall be elected and all annual reports read shall be held on the third Tuesday of January in each year, at ten (10) o'clock A. M., at such place as the Association at the previous annual meeting may designate.

SEC. 2. Whenever the President shall deem it necessary, or upon the written application of fifteen (15) Corporate and Honorary members, stating the necessity of holding a special meeting, he shall direct the Secretary-Treasurer to call such a meeting. The notice thereof shall state the time and place of holding the meeting, and the purpose for which it is called, and shall be mailed not less than thirty (30) days previous to the date of the proposed meeting.

SEC. 3. At all regular meetings of the Association a majority of the Corporate and Honorary members present shall constitute a quorum, but no quorum shall consist of less than twenty (20) Corporate and Honorary members.

SEC. 4. The Association may adopt, from time to time, rules for the order of business at its meetings.

ARTICLE VIII.

Amendments.

SECTION 1. Proposed amendments to this Constitution must be reduced to writing and signed by at least five (5) Corporate and Honorary members and forwarded to the Secretary-Treasurer not less than thirty (30) days prior to the anunal meeting. Advice of such proposed amendment must then be sent by the Secretary-Treasurer to the Corporate and Honorary members, stating that the amendments will be acted upon at the next annual meeting.

SEC. 2. The proposed amendment may be adopted at the annual meeting by a two-thirds (⅔) majority of the Corporate and Honorary members present and voting.

ARTICLE IX.

Publication of Proceedings.

SECTION 1. Whenever it shall be deemed expedient to have the proceedings and discussions of the Association published, proofs of all papers and discussion shall be submitted to the members preparing the papers and those taking part in the discussion, for the purpose of

making necessary changes and corrections, before having them printed in final form.

SEC. 2. As it is not the purpose of this Association to exploit patented or theoretical methods of procedure, or patented or theoretical preservatives, the Executive Committee of this Association is empowered to reject any papers or discussion of such patented or theoretical methods or preservatives.

SEC. 3. In order to conserve the papers read and discussed at the annual meetings of the Association, the same shall be published in book form, known as the Annual Proceedings, to be distributed free among members of the Association, and to outsiders the cost shall be fixed by the Executive Committee.

ARTICLE X.

Procedure Governing Adoption of Standard Specifications.

SECTION 1. Any proposed standard specification must be presented at the annual meeting, at which it may be amended by a majority vote of the Corporate and Honorary members present and voting. A two-thirds (⅔) affirmative vote of the Corporate and Honorary members present and voting shall be required to refer the specification to letter ballot of the Association.

A two-thirds (⅔) affirmative vote of all Corporate and Honorary members of the Association shall be required for the adoption of the specification.

CHANGE OF NAME OF WOOD PRESERVERS' ASSOCIATION TO

AMERICAN WOOD PRESERVERS' ASSOCIATION.

State of Illinois, County of Cook, ss.:

I hereby certify that at a regular annual meeting of the members of the Wood Preservers' Association, held on January 18th, A. D. 1912, at three o'clock P. M., pursuant to the rules of said corporation, the following resolution was adopted, in accordance with the By-Laws of said corporation:

> That the name of the "Wood Preservers' Association" be changed to the "AMERICAN WOOD PRESERVERS' ASSOCIATION."

I further certify that the Wood Preservers' Association has no seal; and that a scroll has been adopted as a seal for this occasion.

F. J. ANGIER, *Secretary.*

State of Pennsylvania, County of Philadelphia, ss.:

I, Ernest A. Sterling, being duly sworn, declare on oath that I am President of the corporation mentioned in the foregoing certificate, and that the statements therein are true in substance and in fact.

In witness whereof I have hereunto set my hand and caused the seal of said corporation to be affixed, this first day of March, A. D. 1912.

E. A. STERLING, *President.*

Subscribed and sworn to before me this first day of March, A. D. 1912.

WILLIAM LINTON, *Notary Public.*
Commission expires March 3, 1912.

F. J. ANGIER
Secretary-Treasurer, 1910-1915

PAST AND PRESENT OFFICERS OF THE AMERICAN WOOD PRESERVERS' ASSOCIATION.

No.	Year Elected.	President.	1st V.-P.	2nd V.-P.	3rd V.-P.	Sec.-Treas.
1st	1905	J. S. Baker	C. B. Lowry†	H. J. Whitmore†	F. A. Kummer*	C. W. Berry
2nd	1906	C. B. Lowry†	E. O. Faulkner	Edmund Christian	David Allerton	C. W. Berry
3rd	1907	C. B. Lowry†	David Allerton	Walter Buehler	H. S. Valentine	C. W. Berry
4th	1908	Walter Buehler	C. B. Lowry	David Allerton	H. S. Valentine	C. W. Berry
5th	1909	Walter Buehler	David Allerton	H. S. Valentine	H. M. Rollins	C. W. Berry
6th	1910	Walter Buehler	C. W. Berry	David Allerton	C. D. Chanute†	F. J. Angier
7th	1911	John T. Logan	Andrew Gibson	R. J. Calder	D. Burkhalter	F. J. Angier
8th	1912	E. A. Sterling	A. M. Smith	H. M. Rollins	G. B. Shipley	F. J. Angier
9th	1913	A. E. Larkin	J. H. Waterman	E. B. Fulks	Geo. E. Rex	F. J. Angier
10th	1914	Geo. E. Rex	Carl G. Crawford	R. S. Manley	F. B. Ridgway	F. J. Angier
11th	1915	J. H. Waterman	H. S. Loud	Lowry Smith	F. D. Beal	F. J. Angier

† Deceased. * Resigned.

NOTE.—In 1915 the Executive Committee was increased to 11 members, the 6 additional members to serve from 1 to 3 years. These six new members are: Geo. E. Rex and Geo. M. Davidson, to serve for three years; J. B. Card and John Foley, for two years, and E. A. Sterling and C. M. Taylor, for one year. This policy was adopted by the Executive Committee, and is based on the votes received by each committee.

CONVENTIONS HELD: ATTENDANCE AND PROCEEDINGS.

Year.	Meeting Place.	Hotel.	Members Present.	Visitors Present.	No. of Pages in Proceedings.	No. of Papers and Reports Presented.
1905........	New Orleans	St. Charles	15	No record	37	7
1906........	Chicago	Palmer House	16	No record	56	9
1907........	Kansas City, Mo.	Gayoso	16	No record	64	10
1908........	Memphis, Tenn.	Baltimore	No record	No record	Not issued	..
1909........	Chicago	Auditorium	..	100	141	12
1910........	Chicago	Auditorium	24	74	190	14
1911........	Chicago	Auditorium	50	70	302	20
1912........	Chicago	Sherman	67	..	348	17
1913........	Chicago	Sherman	83	36	525	22
1914........	New Orleans	St. Charles	65	43	544	25
1915........	Chicago	Congress	122	105	527	23

OFFICERS.

J. H. Waterman..President
H. S. Loud..First Vice-President
Lowry Smith..Second Vice-President
F. D. Beal..Third Vice-President
F. J. Angier..Secretary-Treasurer

EXECUTIVE COMMITTEE.

J. H. Waterman
H. S. Loud
Lowry Smith
F. D. Beal
F. J. Angier
Geo. E. Rex
Geo. M. Davidson
J. B. Card
John Foley
E. A. Sterling
C. M. Taylor

STANDING COMMITTEES.

No. 1.—Committee on Preservatives.

Louis C. Drefahl, *Chairman.*

Ernest Bateman
W. H. Fulweiler
E. B. Fulks
L. B. Shipley
F. W. Kroemer
Wm. W. Hill, Jr.
J. H. Campbell
A. L. Kammerer

No. 2—Committee on Specifications for the Purchase and Preservation of Treatable Timber.

E. A. Sterling, *Chairman.*

Carl G. Crawford
Carlile P. Winslow
Wm. A. Fisher
Lowry Smith
George E. Rex
J. B. Card
O. P. M. Goss

No. 3.—Committee on Wood Block Paving.

CLYDE H. TEESDALE, *Chairman.*

F. P. Hamilton
H. S. Loud
H. M. Newton
Frank W. Cherrington

No. 4.—Committee on Plant Operation.

A. L. Kuehn, *Chairman.*

Frank McArdle
A. M. Lockett
C. W. Lane
August Meyer

No. 5.—Committee on Service Tests.—Cross Ties.

Carlile P. Winslow, *Chairman.*

Geo. L. Pollock	F. S. Pooler
F. D. Mattos	L. T. Ericson
C. F. Ford	C. E. Gosline

No. 6—Committee on Service Tests.—Wood Block Paving.

A. E. Larkin, *Chairman.*

L. B. Moses	E. G. Draper
R. S. Manley	F. D. Beal

No. 7.—Committee on Service Tests.—Bridge and Structural Timber.

H. M. Rollins, *Chairman.*

Dr. Hermann von Schrenk	H. E. Horrocks
R. J. Calder	Earl Stimson

Advertising Committee.

F. J. Angier, *Chairman.*

F. D. Beal	Wm. Townsley, Jr.

Entertainment Committee.

A. R. Joyce, *Chairman.*

F. D. Fenn	W. C. Gibson
C. F. Ford	Russell Lord

Publicity and Promotion Committee.

C. C. Schnatterbeck, *Chairman.*

Carl G. Crawford	E. T. Howson
Dr. Hermann von Schrenk	P. S. Ridsdale

Statistical Committee.

E. T. Howson, *Chairman.*

M. K. Trumbull	O. T. Swan

Notice—The Association is not responsible as a body for the opinions or views expressed by individuals.

LIST OF MEMBERS.

c-Corporate. a-Associate. j—Junior. h-Honorary. Figures indicate serial number of Membership Certificate.

183 c ALEXANDER, E. E.......Chief Engineer, Timber Preserving Plant, B. & O. R. R. Co., Green Spring, W. Va.
29 c ALLARDYCE, R. L.......Supt. International Creosoting & Construction Co., Texarkana, Tex.
21 c ALLERTON, DAVID......Carlotta, Cal.
1 c ANGIER, F. J.............Supt. of Timber Preservation, B. & O. R. R., Baltimore, Md.
274 c APPEL, HARRIS A.......Engr., Carbolineum Wood Pres. Co., 182 Franklin St., N. Y.
251 c ARMSTRONG, L. R.......Vice-Pres. & Treas., T. J. Moss Tie Co., Security Bldg., St. Louis, Mo.
2 c ARMSTRONG, R. L.......636 Burdette St., New Orleans, La.
105 c BACON, W. L............Supt. Tie Treating Plant, C. & N. W. Ry., Escanaba, Mich.
225 c BAKER, HUGH P.........Dean, New York State College of Forestry, Syracuse University, Syracuse, N. Y.
3 h BAKER, J. S..............Ayer & Lord Tie Co., Box 22, Paducah, Ky.
95 a BARNARD, F. M..........Care of Creosoted Wood Paving Block Bureau, 30 N. LaSalle St., Chicago, Ill.
167 c BATEMAN, ERNEST.....Chemist, Forest Products Laboratory, Madison, Wis.
246 c BATES, JOHN S..........Supt. Forest Products Laboratories, McGill University, Montreal, Canada.
88 c BATSON, C. D............Manager, Republic Creosoting Co., Mobile, Ala.
4 c BEAL, F. D...............Gen. Manager, St. Helens Creosoting Co., Portland, Ore.
255 c BEATY, R. ERNEST......Expert Inspector, Borough of Manhattan, 43 Washington Square South, New York.
198 c BECKER, A. C............Chief Tie & Timber Inspector, Grand Trunk Ry., Montreal, Canada.
145 c BELCHER, R. S...........Supt., Santa Fe Tie & Lumber Pres. Co., Somerville, Tex.
144 e BERK, P. F...............Chemical Mfr., F. W. Berk & Co., Ltd., 1 Fenchurch Ave., London, England.
5 h BERRY, C. W.............Consulting Engineer, care of J. B. Berry, Transportation Bldg., Chicago, Ill.
22 c BOEHNE, E. E............Office Manager, International Creosoting & Construction Co., Galveston, Tex.
258 c BOOK, J. E...............Treating Engineer, Pacific Creosoting Co., Creosote, Wash.
244 c BOWSER, E. H...........Supt. of Timber Department, I. C. R. R., Memphis, Tenn.
267 a BOYD, F. L...............Pres., Creosoted Block Paving Co., 84 Victoria St., Toronto. Canada.
175 c BRANNON, CLIFTON....Asst. Engineer, C. & E. I. Ry., 7700 Wallace St., Chicago, Ill.
280 j BRENNAN, T. S..........Lumber Inspr., A., T. & S. F. Ry., Box 503, Ballard Sta., Seattle, Wash. (1915).
230 c BROWN, NELSON C......Professor of Forest Utilization, New York State College of Forestry, Syracuse, N. Y.
122 c BRUNING, HEINRICH....(Robert A. Munro & Co., 31 Liberty St., New York City) Hubertusmuhle, Schopfurth, Mark, Germany.
23 c BUEHLER, WALTER.....Vice-Pres., Butler-Coons Contracting Co., 4300 Fremont Ave. South, Minneapolis, Minn.
24 c BURKHALTER, D.........American Creosoting Co., Paterson, N. J.
83 a CABOT, SAMUEL........Mfg. Chemist, 141 Milk St., Boston, Mass.
30 c CALDER, R. J............Sec.-Treas., International Creosoting & Construction Co., Galveston, Tex.
190 c CAMPBELL, J. H.........Chief Chemist, R. W. Hunt & Co., 2200 Insurance Bldg., Chicago, Ill.
43 c CARD, J. B...............Manager, Chicago Creosoting Co., 30 N. LaSalle St., Chicago, Ill.
276 c CECIL, WM. A............Wood Preserving Engineer, Indiana Tie Co., Evansville, Ind. (1915).
257 c CHADBOURNE, B.........Asst. Supt., Pacific Creosoting Co., Creosote, Wash.
69 c CHERRINGTON, F. W....Chief Engr., Jennison-Wright Co., 313 Huron St., Toledo, O.
19 c CHRISTIAN, EDMUND...Gen. Mgr., Norfolk Creosoting Co., Norfolk, Va.
57 a CHURCH, SUMNER R....Manager Research Dept., Barrett Mfg. Co., 17 Battery Place, New York.
184 c CLARK, W. DENNISON..Vice-Pres. & Gen. Mgr., Columbia Creosoting Co., 810 Lewis Bldg., Portland, Ore.
165 c CLARKE, G. I.............Vice-Pres. & Gen. Mgr., Reeves Co., New Orleans, La.
174 c CLIFTON, W. H..........Lumber Agent, B. & O. R. R., Baltimore, Md.
249 c COBEAN, CHAS. E.......Supt., Pacific Creosoting Co., Creosote, Wash.
188 a COCKE, W. H.............Pres., Commercial Acid Co., 3943 Duncan Av., St. Louis, Mo.
157 a COLLIER, H. L..........Con. Engr., 252 W. Peachtree St., Atlanta, Ga.
218 c COLLIVER, S. R..........Treatment Inspector, A., T. & S. F. Ry., Topeka, Kan.

67 c COLMAN, GEO. A........Colman Creosoting Works, Colman Bldg., Seattle, Wash.
221 c COOPER, S. D............Chief Clerk, Manager Treating Plants, A., T. & S. F. Ry., Topeka, Kan.
55 c COTTER, GEO. F.........Pres., G. F. Cotter Supply Co., 406 Southern Pacific Bldg., Houston, Tex.
219 c COWAN, HERBERT W....Chief Engineer, Colo. & Sou. Ry., Denver, Colo.
31 c CRAWFORD, CARL G.....Gen. Mgr., American Creosoting Co., 808 Columbia Bldg., Louisville, Ky.
80 c CURTIS, W. W...........Pres. & Treas., The Rapson Coal Mining Co., Box 485, Colorado Springs, Colo.

25 c DAVIDSON, G. M.........Chemist & Engineer of Tests, C. & N. W. Ry., Chicago, Ill.
143 c DAVIES, E. T............Inspector, City Engineer's Office, Minneapolis, Minn.
84 c DE CEW, J. A............Chemical Engineer, Canadian Express Bldg., Montreal, Can.
272 c DELIUS, E. A............Bookkeeper, Pacific Creosoting Co., Seattle, Wash.
204 c DEMUTH, R. E...........Testing Engineer, St. Helens Creosoting Co., St. Helens, Ore.
223 c DIXON, G. C.............Tie Treating Inspector, N. Y. C. Lines, Box 763, Indianapolis, Ind.
64 c DIXON, J. H..............Dept. Natural Resources, Canadian Pac. Ry., Calgary, Alta, Canada.
119 c DOUGHERTY, CURTIS...Chief Engineer, Queen & Crescent R. R., Cincinnati, O.
121 c DRAPER, E. G............Pres., American Creosoting Co. of N. J., 17 Battery Place, New York.
166 a DREFAHL, LOUIS C.....Chemist, Grasselli Chemical Co., 880 The Arcade, Cleveland, Ohio.
93 c DRINKER, W. W..........Asst. Engineer, Erie R. R. Co., 50 Church St., New York.
178 c DUNSTAN, J. H.........Supt.. Southern Creosoting Co., Slidell. La.
211 c DURHAM, J. H..........Vice-Pres., American Creosoting Co., Louisville, Ky.

202 a EASTWICK, CHAS. H.....Pres., Northeastern Co., 6 Beacon St., Boston, Mass.
74 c ELDRIDGE, W. W........Piece Work Inspector, C., B. & Q. R. R., 221 Liberty St., Aurora, Ill.
156 a ELLIS, CARLETON.......Pres., Copper Oil Products Co., 143 Gates Av., Montclair, N.J.
275 c EMERSON, HARRINGTON Pres., The Emerson Co., 30 Church St., New York.
76 c EPPINGER, JESSE I.....Gen. Mgr., Eppinger & Russell Co., 165 Broadway, New York.
163 c ERICSON, L. T..........Engineer, American Creosoting Co. of N. J., 17 Battery Place, New York.

158 c FANT, A. E...............Gen. Mgr., Gulfport Creosoting Co., Gulfport, Miss.
9 h FAULKNER, E. O.........Mgr., Tie & Timber Dept., A., T. & S. F. Ry., Kerckhoff Bldg., Los Angeles, Cal.
159 a FENN, FRANK D.........Mgr., Railroad Sales Dept.. The Crane Co., Chicago, Ill.
239 c FERGUSSON, HUBERT...Gen. Mgr., Burt, Boulton & Haywood, Ltd., Prince Regents Wharf, Silverton, Victoria Docks, London, England.
237 c FINKE, W. F. H..........Tie & Timber Agent, Southern Ry. Co., Washington, D. C.
62 c FISHER, WM. A..........Supt. of Timber Preservation, Atlantic Coast Line, Gainesville, Fla.
77 c FOLEY, JOHN............Forester, P. R. R. Co., Broad St. Station, Philadelphia, Pa.
106 c FORD, C. F..............Supt. Tie and Timber Dept., C., R. I. & P. R. R., 325 LaSalle St., Chicago, Ill.
117 c FREY, GEO. W...........Sec.-Treas. & Mgr., Compressed Wood Preserving Co., 4600 Spring Grove Ave., Cincinnati, O.
38 c FULKS, E. B.............Vice-Pres. & Gen. Mgr., American Tar Products Co., 208 S. LaSalle St., Chicago, Ill.
160 a FULWEILER, W. H......Chemist, United Gas Improvement Co., 1706 N. Broad St., Philadelphia, Pa.

44 a GERHARD, H. H.........Prest. C-A-Wood Preserver Co., St. Louis, Mo.
39 c GIBSON, ANDREW.......Engineer Maintenance of Way, No. Pac. Ry., St. Paul, Minn.
161 a GIBSON, LOUIS S........Sec., Sandoval Zinc Co., 410 N. Peoria St., Chicago, Ill.
180 a GIBSON, W. C............Sales Engineer, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
56 c GOLTRA, W. F............Pres., W. F. Goltra Tie Co., Rockefeller Bldg., Cleveland, O.
169 a GOODLETT, EARL G.....District Sales Manager, American Tar Products Co., 1505 Jefferson Co. Bank Bldg., Birmingham, Ala.
288 c GOSLINE, C. E......... Treating Inspector, D., L. & W. R. R. Co., Boonton, N. J.
277 c GOSS, O. P. M............Consulting Engineer, 910 White Bldg., Seattle, Wash. (1915).
243 c GRADY, W. H............Asst. Gen. Supt., American Creosoting Co., Louisville, Ky.
100 c GRAHAM, FLOYD N.......Timber Inspector, C. G. W. R. R., Chicago, Ill.
170 c GREEN, DONALD W......Sec., Columbia Creosoting Co., 809 Lewis Bldg., Portland, Ore.
232 c GRIFFIN, RUSSELL A....Mgr. Pole Dept., Western Electric Co., New York.
72 a GROW, J. H..............Sales Engineer, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

48 c HAGEBOECK, A. E.......Manager Plant, F. J. Lewis Mfg. Co., 2500 S. Robey St., Chicago, Ill.

231 c	HAGGANDER, G. A.	Asst. Bridge Engineer, C., B. & Q. R. R. Co., 547 W. Jackson Blvd., Chicago, Ill.
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Book, J. E.
Chadbourne, B.
Cobean, Chas.
Delius, E. A.
Horrocks, H. E.
Redman, Kenneth
Roe, George J.

PITTSBURGH WOOD PRESERVING CO.:
Rodd, Thos., Jr.
Shipley, Grant B.

PUGET SOUND WOOD PRESERVING CO.:
Ikin, Arthur John

REEVES CO.:
Clarke, G. I.

REPUBLIC CREOSOTING CO.:
Batson, C. D.
Hess, L. E.
Larkin, A. E.
Rufle, H. M.
Shuford, C. S.
Welsh, C. T.

RUTGER WORKS:
Segall, S.
Zwingauer, N.

ST. HELENS CREOSOTING CO.:
Beal, F. D.
Demuth, R. E.
Rawson, R. H.

ST. PAUL & TACOMA LUMBER CO.:
Lane, C. E.
Wegener, R. H.
Winslow, Geoffrey

SOUTHERN CREOSOTING CO.:
Dunstan, J. H.

SOUTHERN WOOD PRESERVING CO.:
Meredith, W. C.

UNITED GAS IMPROVEMENT CO.:
Fulweiler, W. H.

UNITED STATES WOOD PRESERVING CO.:
Loud, H. S.

WATKINS CREOSOTING CO.:
Helson, J. R.

WESTERN WOOD PRESERVING CO.:
Lindsley, S. B.

Tie and Lumber Companies.

ACME TIE CO.:
Tiffany, C. W.

BATHURST LUMBER CO.:
McIntyre, A. G.

THE W. F. GOLTRA TIE CO.:
Goltra, W. F.

B. JOHNSON & CO.:
Johnson, J. H.

LONG BELL LUMBER CO.:
Parminter, L. I.

MINE & TIMBER PROPRIETORS:
Nelson, J. M., Jr.

MITSUI & CO.:
Takaki, Shunzo

SIGNOR TIE CO.:
Signor, G. W.

SOUTHERN TIE & LUMBER CO.:
Swink, R. B.

WALSH-GRIFFITH TIE & LUMBER CO.:
Walsh, R. P.

WESTERN TIE & TIMBER CO.:
Nixon, E. A.

Chemical and Manufacturing Concerns.

ALLIS-CHALMERS MFG. CO.:
Gibson, W. C.
Grow, J. H.

AMERICAN TAR PRODUCTS CO.:
Fulks, E. B.
Goodlett, E. G.
Shryer, F. W.

ANTHROL WOOD PRESERVER CO.:
Wirth, Philipp

BARRETT MANUFACTURING CO.:
Church, Sumner R.
Shipley, L. B.

BERK & CO., F. W.:
Berk, P. F.

C-A-WOOD PRESERVER CO.:
Gerhard, Harry H.

CHATFIELD MANUFACTURING CO.:
Sjodahl, H. A.

COMMERCIAL ACID CO.:
Cocke, W. H.

COPPER OIL PRODUCTS CO.:
Ellis, Carleton

CRANE CO.:
Fenn, Frank D.

GENERAL CHEMICAL CO.:
Hawkes, A. W.
Stahl, K. F.

GRASSELLI CHEMICAL CO.:
Drefahl, L. C.
Mills, W. C.
Townsley, Wm.

GREENLEE BROTHERS & CO.:
Lounsbury, Jas. A.

LEMBCKE, VON BERNUTH CO.:
Lange, Albert
Lembcke, G. A.
von Bernuth, Oscar

LEWIS MFG. CO., F. J.:
Hageboeck, A.
Lewis, F. J.
Lewis, W. H.

LOCKETT CO., A. M.:
Lockett, A. M.

LUND & CO., C. A.:
Lund, C. A.

THE NORTHEASTERN CO.:
Eastwick, Chas. H.

REEVES BROTHERS & CO.:
Newton, G. H.

SANDOVAL ZINC CO.:
Gibson, L. S.

GEO. W. SAUMS CO.:
Saums, Geo. W.

WESTERN ELECTRIC CO.:
Griffin, R. A.
Sexton, C. H.

Consulting Engineers, Chemists, Etc.

Allerton, David
Armstrong, R. L.
Berry, C. W.
Cabot, Samuel
Campbell, J. H.
Collier, H. L.
De Cew, J. A.
Emerson, Harrington
Goss, O. P. M.
Hamnett, W. S.
Kammerer, A. L.
Ridgway, F. B.
Roberts, G. G.
Robinson, Donald
Smith, V. C.
Sterling, E. A.
von Schrenk, Dr. Hermann
Moll, Dr. Friedrich
Okes, Day
Powell, A. O., Jr.
Quincy, R. B.

United States Forest Service.

Bateman, Ernest
Hunt, Geo. M.
Teesdale, Clyde H.
Weiss, Howard F.
Winslow, Carlile P.

Wood Block Paving Associations.

Barnard, F. M.

Educational Institutions.

McGILL UNIVERSITY:
Bates, John S.
Kynoch, Wm.

NEW YORK STATE COLLEGE OF FORESTRY:
Baker, Hugh P.
Brown, Nelson C.

YALE FOREST SCHOOL, YALE UNIVERSITY:
Record, Samuel J.

Municipalities.

BOROUGH OF MANHATTAN, OF NEW YORK:
Beaty, R. Ernest

CITY ENGINEER'S OFFICE, MINNEAPOLIS:
Davies, E. T.

DEPARTMENT OF WORKS, MONTREAL:
Marriott, F. G.

Periodicals.

AMERICAN FORESTRY:
Ridsdale, P. S.

RAILWAY AGE GAZETTE:
Howson, E. T.

WOOD-PRESERVING:
Schnatterbeck, C. C.

Miscellaneous.

BUTLER-COONS CONTRACTING CO.:
Buehler, Walter

COTTER SUPPLY CO.:
Cotter, Geo. F.

CREOSOTED WOOD BLOCK PAVING CO., CANADA:
Boyd, J. L.

CREOSOTED WOOD BLOCK PAVING CO., NEW ORLEANS:
Manley, R. S.

NEW ORLEANS CUBAN STEAMSHIP CO.:
Powell, E. L.

NORTHERN HEMLOCK & HDW. ASSN.:
Swan, O. T.

RAPSON COAL MINING CO.:
Curtis, W. W.

SAGAMORE WATER CO.:
Watson, B. F.

STANDARD OIL CO.:
Smith, R. G.

STANDARD WOOD PRODUCTS CO.:
Sackett, H. S.

LIST OF ATTENDANCE AT ELEVENTH ANNUAL CONVENTION OF AMERICAN WOOD PRESERVERS' ASSOCIATION.

Members.

Angier, F. J.
Armstrong, L. R.

Bacon, W. L.
Bateman, Ernest
Beal, F. D.
Becker, A. C.
Berry, C. W.
Brown, Nelson C.

Campbell, J. H.
Card, J. B.
Cecil, Wm. A.
Cherrington, Frank W.
Church, Samuel R.
Clifton, W. H.
Cobean, Chas. E.
Cocke, W. H.
Collier, H. L.
Cooper, S. D.
Crawford, Carl G.

Davidson, Geo. M.
Davies, E. T.
DeCew, J. A.
Dixon, G. C.
Dunstan, J. H.
Drefahl, L. V.

Eastwick, Chas. H.
Emerson, Harrington

Fenn, Frank D.
Fisher, Wm. A.
Foley, John
Ford, C. F.
Frey, Geo. W.
Fulks, E. B.
Fulweiler, W. H.

Gerhard, Harry H.
Gibson, Andrew
Gibson, W. C.
Goltra, W. F.
Goss, O. P. M.
Grady, W. H.
Graham, Floyd N.
Green, Donald W.
Grow, J. H.

Hageboeck, A. C.
Haggander, G. A.
Hamnett, W. S.
Harden, G. S.
Helson, James R.
Hendricks, V. K.
Hess, L. E.
Hill, Wm. W., Jr.
Howson, E. T.
Hunt, Geo. M.

Johnson, J. A.
Johnson, John H.
Joyce, A. R.

Kent, A. S.
Kroemer, F. W.
Kuehn, A. L.

Larkin, A. E.
Lawson, W. W.
Lembcke, G. A.
Lewis, F. J.
Lewis, W. H.
Lockett, A. M.
Look, Richard V.
Lord, Russell
Loud, H. S.
Lounsbury, J. A.

Maitland, Geo. F.
Martin, F. R.
Mattos, Frank D.
McArdle, Frank
McCandless, S. F.
Meyer, August
Mills, W. C.
Moore, Robert H.
Moses, L. B.

Newton, H. M.
Noyes, A. H.

Paddock, Edw. F.
Park, E. S.
Parminter, L. I.
Paul, H. A.
Perry, A. W.
Pollock, Geo. L.

Rex, Geo. E.
Robinson, Donald R.
Rollins, H. W.

Sackett, H. S.
Schilling, Frank
Schnatterbeck, Chas. C.
Scholtz, A. C.
Shipley, Grant B.
Shipley, L. B.
Shryer, F. W.
Signor, Geo. W.
Sjodahl, H. A.
Smith, Lowry
Smith, Phil R.
Smith, W. J.
Stahl, K. F.
Steinmayer, O. C.
Sterling, E. A.
Stimson, Earl
Stocking, E. J.

Taylor, C. M.
Teesdale, Clyde H.
Tiffany, C. W.
Tilley, C. M.
Townsend, T. G.
Townsley, Wm.
Trumbull, M. K.

Van Metre, Ricker
Von Leer, H. J.
von Schrenk, Hermann

Walsh, P. R.
Waterman, J. H.
Watkins, W. T.
Weiss, Howard F.
Williams, R. R.
Williamson, H. E.
Winslow, Carlile P.
Woodward, G. W.

Non-Members.

ANGIER, ROBERT N.	Special Apprentice, B. & O. R. R., Baltimore, Md.
ANGLE, H. M.	President, American Wood Reduction Co., Chicago.
ARMSTRONG, F. W.	Convention Bureau, Chicago, Association of Commerce, Chicago.
BARMEIER, F. E.	Chemist, Chicago.
BELANGER, ERNEST	Consulting Engineer, Elder Ebano Asphalt Co., Montreal, Canada.
BENNETT, MARCH G.	General Manager, Samuel Cabot, Inc., Boston.
BOWER, T. T.	Assistant Efficiency Engr., The Emerson Co., Baltimore, Md.
BRIGHT, C. W.	Vice-President, St. Louis Lumberman, St. Louis.
BROWER, ASA L.	Forest Examiner, U. S. Forest Service, Ogden, Utah.
BROWNE, H. B.	Chief Clerk, Testing Department, C. & N. W. Ry., Chicago.
BRYAN, GORDON	Engineer, Portable Band Saw Mill, Inc., New York City.
BURY, R. V.	Assistant General Tie Agent, N. Y. C. Lines, Detroit, Mich.
CARY-CURR, HENRY J.	Apparatus Engineer, E. H. Sargent & Co., Chicago.
CHADWICK, CHAS. S.	Secretary and Treasurer, Eppinger & Russell Co., New York.
CHRISTERSON, O. G.	Representing Orenstein Arthur Koppel Co., Chicago.
CLIFFORD, E. A.	Asst. General Purchasing Agent, A., T. & S. F. Ry., Chicago.
CONE, ALBERT	Associate Editor, "American Lumberman," Chicago.
CORY, F. P.	Vice-President, The McClure Co., Saginaw, Mich.
DeBERARD, WILLIAM	Western Editor, "Engineering Record," Chicago.
DREWITZ, ERNEST	Representing "Illinois Staats Zeitung," Chicago.
EMERSON, MRS. HARRINGTON	New York City.
EVANS, B. B.	Salesman, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
FINLEY, W. H.	Chief Engineer, C. & N. W. Ry., Chicago.
FIELDS, S. H.	Assistant to President, American Tar Products Co., Chicago.
FISHER, MRS. WM. A.	Gainesville, Fla.
FOARD, J. W.	Secretary to Engr., M. of W., B. & O. R. R., Baltimore, Md.
FULLER, L. E.	Associate Editor, "Lumber World Review," Chicago.
GOSLINE, C. E.	Treating Inspector, D., L. & W. Ry. Co., Paterson, N. J.
GREENBERGER, MILTON	Assistant Secretary, Theodore Seissmann & Co., Chicago.
GREENE, CHAS. W.	Tie Treating Inspector, N. Y. C. Lines, Toledo, O.
GRIFFITHS, P. L.	Sales Manager, American Tar Products Co., Chicago.
GROW, MRS. J. H.	Milwaukee, Wis.
GURTLER, FRED. H.	Official Stenographer, Chicago.
HAAS, E. M.	Western Editor, "Electric Railway Journal," Chicago.
HARRISON, A. H.	Salesman, John A. Roebling's Sons Co., Chicago.
HIRSH, DR. J. M.	Chemist and Physician, Chicago.
HOXIE, F. J.	Engineer & Special Inspector, Associated Factory Mutual Fire Insurance Companies.
HOYT, C. B.	Supt., T., M. & C., N. Y. C. & St. L. R. R., Bellevue, O.
HUMPHREY, C. J.	Forest Products Laboratory, Madison, Wis.
HUTCHINS, C. B.	Sales Agent, Booth-Kelly Lumber Co., Chicago.
HUTCHINS, RALPH G.	Booth-Kelly Lumber Co., Chicago.
JACKSON, F. V.	Sales Department, American Tar Products Co., Chicago.
JACOB, DAN R.	Tie Inspector, N. Y. C. Lines, Toledo, O.
JOHNSON, F. J.	Managing Partner, American Hoist & Derrick Co., Chicago.
KENNY, J. A.	Sales Agent, C-A-Wood Preserver Co., Chicago.
KITCHEN, P. C.	Student of Forestry, Ohio State University, Columbus, O.
LAYDEN, T. E.	Assistant Engineer of Tests, A., T. & S. F. Ry., Topeka, Kan.
LEITCH, ALBERT J.	Cleveland, O.
LICHTY, C. A.	General Inspector, C. & N. W. Ry., Chicago.
MacFARLAND, H. B.	Engineer of Tests, A., T. & S. F. Ry., Chicago.
McGUIRE, G. C.	Street Inspector, Milwaukee, Wis.
McILRAVY, W. N.	Vice-President, Barrett Mfg. Co., New York City.
MINWEGAN, J. A.	Engineering Department, Crane Co., Chicago.
MITCHELL, W. G.	Division of Wood Preservation, Forest Products Laboratories of Canada, Montreal, Canada.
MUMMERT, M. A.	Manager, Hayden & Westcott Lumber Co., Chicago.
MURPHY, R. L.	Tie and Timber Agent, Queen & Crescent Route, Cincinnati.

NICHOLS, C. H.......................Assistant Superintendent of Treating Plants, No. Pac. Ry., Paradise, Mont.
NICHOLS, HENRY W...........Assistant Curator of Geology, Field Museum, Chicago.
NISBET, W. C.....................Efficiency Engineer, B. & O. R. R., Baltimore, Md.

OSBORN, S. R....................Chicago Association of Commerce, Chicago.

PAGENSTECHER, H............ Representing Hohman & Maurer Division Taylor Instrument Cos., Chicago.
PEARCE, W.......................Superintendent, American Creosoting Co., Marion, Ill.
PETERS, E. W....................Forester, U. S. Forest Service, Chicago.

RABOURN, M. M..................Treating Inspector, C. & E. I. R. R., Evansville, Ind.
RABOURN, MRS. M. M..........Evansville, Ind.
REISER, L. J.....................Assistant Superintendent of Tie and Timber Department, C., R. I. & P. Ry., Chicago.
RIEGLER, L. J..................Engineer, P. R. R., Pittsburgh, Pa.
ROBINSON, A. F..................Bridge Engineer, A., T. & S. F. System, Chicago.
ROBINSON, CHAS. J.............Efficiency Engineer, The Emerson Co., Chicago.
ROBINSON, DONALD R.........Chicago.
ROBINSON, WILLIAM..........Tie and Treating Inspector, C. & W. I. R. R., Chicago.
RODGERS, JOHN.................Chemist, City of Milwaukee, Milwaukee, Wis.
ROOT, F. J.......................Secretary, American Wood Reduction Co., Chicago.
ROSS, O. C.......................Sales Engineer, Allis-Chalmers Mfg. Co., Indianapolis, Ind.
ROSSBACH, CHAS...............Buyer and Inspector, C. & N. W. Ry., Chicago.
RUTLEDGE, R. A................Chief Engineer of Eastern Lines, A., T. & S. F. Ry., Topeka, Kan.

RYAN, I. J.......................Chief Tie Inspector, C. & E. I. R. R., Marion, Ill.

SACKETT, H. S...................Standard Wood Products Co., Chicago.
SHACKELL, DR. L. F...........Assistant Professor of Pharmacology, St. Louis University, St. Louis. Mo.
SHANESEY, W. T................General Tie Inspector, N. Y. C. Lines, Ann Arbor, Mich.
SHENTON, W. H.................Manager of Western Department, Schaeffer & Budenberg Mfg. Co., Chicago.
SHORT, W. A. D.................Editor, "Railway Engineering & M. of W.," Chicago.
SIMMONS, H. H.................Assistant Engineer, Editor, "Railway Age Gazette," Chicago.
STEVENS, CHESTER N.........Assistant Manager, Barrett Mfg. Co., Chicago.
STEWART, P. A..................President, Kickapoo Sand and Gravel Co., Attica, Ind.
SULLIVAN, J. G.................Treating Inspector, Elgin, Joliet & Eastern Ry., Chicago.

TAYLOR, THOMAS B............Asst. to President, American Creosoting Co., Louisville, Ky.
THIELL, J. E.....................Advertising Mgr., Manitowoc Engineering Co., Manitowoc, Wis.

TRATMAN, E. E. R..............Editor, "Engineering News," Chicago.
TREAT, B. F.....................Chief Tie Inspector, C., R. I. & P. Ry., Little Rock, Ark.

ULMANN, E. A..................C. J. Tagliabue Mfg. Co., Chicago.

VANDER STARR, M............Superintendent, Chicago Creosoting Co., Waukegan, Ill.
VON LEER, MRS. H. J...........Shenandoah, Pa.

WATERSTREET, E. H...........Passenger Agent, C. & N. W. Ry., Chicago.
WEIKE, H. W.....................American Wood Preserving Co., Chicago.
WENDT, E. W....................Salesman, Taylor Instrument Companies, Chicago.
WHITE, J. L......................Chicago, Indianapolis & Louisville Ry., Chicago.
WHITE, W. W....................Manager, Chicago Branch, C. J. Tagliabue Mfg. Co., New York.

WILLIAMS, PROF. S. N.........Professor Emeritus Civil Engineering, Cornell College, Mt. Vernon, Iowa.
WILLIAMS, W. E................Consulting Engineer, Chicago.
WILSON, LLOYD R...............Assistant Sales Manager, Lakewood Engineering Co., Cleveland, O.
WRIGHT, H. E....................Chemist, Robert Hunt & Co., Chicago.

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OPENING SESSION.

January 19, 1915.

The Eleventh Annual Convention of the American Wood Preservers' Association, held in the Florentine Room, Hotel Congress and Annex, Chicago, Illinois, January 19, 20 and 21, 1915, was called to order by the President, Mr. George E. Rex, at 10:30 o'clock Tuesday morning, January 19.

THE PRESIDENT: Ladies and gentlemen, we are delighted this morning to have you all with us on this the opening of our Eleventh Annual Convention, which we hope is the beginning of a new era in our Association work. We will dispense with the address of welcome and the response this morning on account of desiring to get rather far along with our work and hoping to be able to spend the last afternoon in going to Madison. We want to try and get our Association work as far forward as possible. We will now proceed with the roll call.

Secretary Angier then called the roll, showing that there were 124 members and 100 visitors present, as listed on pages 28, 29 and 30.

THE PRESIDENT: There are a great many other members in the hotel who have not answered to their names. I hope all will try to be present as much as possible at each session, so that we may all take part in the discussion. We will dispense with the reading of the minutes of our last meeting, and the report of the President will be presented. I believe you all have copies of this report.

President's Address.

Last year, at New Orleans, when some of my friends suggested that my name should be considered for the Presidency, of our honorable Association, I protested very vigorously and thought I had succeeded in heading off the suggestion, (not that I was insensible to the honor that you were paying me,) but that I could not make you

an address, and the few words I have to offer at this time, are not to be designated by that name.

I consider the real idea and life of the American Wood Preservers' Association dates from the time, when, under the able leadership of Mr. Sterling, we adopted the committee form of investigation and reports. and while the result of this step is not as yet fully manifest, and our committee reports have of course, not reached their full swing of usefulness that they will later assume, yet the work done by these committees is growing and rapidly assuming the position that they should righfully occupy, and I hope, during this very Convention we will come out unanimously for certain recommendations that will carry weight to the purchasing public in these times when the lines of trade are so rent asunder by this awful calamity of war.

And, fellow members, there is not a profession in our country that is more affected by this calamity than ours, and if we will step in to the breach at this time, with good conservative and unanimous recommendations as to what should be done in the treating business at this time, our future, as an Association, will be assured.

So let me plead with you to get together and lay aside all personal considerations and come out strong for the best practice in the preservation field and adopt specifications that will be standard.

The field of specifications is a wide one, and each particular association should be considered as authority by all others on certain subjects, which they are best qualified to supply. For instance, I think we should, without question, accept the American Railway Engineering Association's specifications as authoritative for bridges, buildings, tracks, etc., the American Society for Testing Materials for specifications on grades of timber, steel, etc., the Signal Association for the best practice in railway signaling, and the American Wood Preservers' Association for specifications on creosote, zinc chloride and all methods appertaining to treatment.

But let me tell you gentlemen, we have got to do good conscientious and meritorious work in our line, if we are to fill this place, and unless we do fill it, our Association is a failure.

So, I hope the committees and those of you who discuss the work of these committees will bear these things in mind and will only more closely "hew to the mark," in their deliberations in this Convention.

Committee work of this kind necessarily falls upon those who are busy men and widely scattered geographically, and the greatest drawback to the successful carrying on of this work, is, that defined plans and dates are not made for these meetings, sufficiently in advance to allow the members to arrange for attendance.

So allow me to suggest that before the Chairmen of the various standing committees leave Chicago this week, they assign definite dates

through the year for their committee meetings, and, so far as possible get them grouped, so that several committees meet at the same time, on the same date, and thus make an extra inducement for the members of committees to get together.

I don't think our Association has ever had a "get together meeting," that did more to advance the interests of the Association than the one we had here in Chicago last March, and two or three such meetings a year would soon accomplish what we are after, and draw the members closer together and thus succeed in getting a unanimous expression of the best practice in our profession which by their unanimity would accomplish our good.

What we need above all else is the entire time of an enthusiastic and competent man as Secretary to take charge of and devote his time to the Association's interests,—and, while our present Secretary has been untiring in his efforts and has devoted weeks and months of his time to the interest of our Association almost without compensation, and, let me add, "has been signally successful in his efforts," yet we cannot expect to continue this and make demands upon his time without compensation.

I early realized the injustice of this arrangement, and while I have been compelled to constantly call upon Mr. Angier for help in every direction, which I want to say has been responded to by him most freely and enthusiastically, yet I could not but feel the injustice of this arrangement and look for methods that would put it on a different footing.

The first step necessary to accomplish this end is increased revenue, and the only method of increasing our revenue was increased membership, so that early in the year we started a vigorous campaign for 100 new members, which if it had been a normal year, we would have accomplished without question.

But, even with the handicap of the war, which has so disorganized the principal source of supply for the wherewithall to carry on our industry, and has made it necessary for more than one half of the entire industry to reverse its methods, we have succeeded in securing about 85 new members for our Association, which shows a gain of 50 per cent in the year.

With these healthy gains in our membership and the new life blood they will bring to the Association, I certainly think we have reason to congratulate ourselves upon our future and I hope these results will, in a way, be an inspiration to our new officers that will encourage them to greater and more successful efforts during the coming year.

My proudest hope is to see the Association in not more than another year to be financially able to sufficiently employ a man for at least one-half, if not the whole, of his time, to look after the interests of our Association.

I cannot close without expressing my deep and profound appreciation for the untiring and intelligent efforts of our Secretary for our advancement also the cheerful and enthusiastic support of our Vice Presidents, and committeemen, in carrying forward our work, and can wish my successor no better success than that he will be as ably supported in the accomplishment of the tasks he sets for himself.

I thank you.

THE PRESIDENT: The next on our program will be the report of our Secretary-Treasurer.

Mr. Angier then read his report as follows:

ANNUAL REPORT OF THE SECRETARY-TREASURER.

To the Members of the American Wood Preservers' Association:

Gentlemen: Your Secretary-Treasurer begs to submit herewith his annual report for the year 1914:

Cash on hand December 31, 1913		$1,071.16
Receipts.		
Initiation fees	$ 925.00	
Membership dues	2,085.00	
Advertising—Proceedings	1,184.00	
Advertising—Bulletin	33.00	
Refund from Forest Prod. Expo. Com.	104.72	
Sale of Proceedings	200.85	
Interest on funds in bank	33.21	
Subscriptions to Bulletin	33.00	4,599.08
Total cash balance and receipts for year		$5,670.24

Disbursements.

Reporting and printing 1914 Proceedings	$1,717.25
Postage, expressage and telegrams	315.13
Office supplies, stationery, printing, clerical and stenographic work	1,165.27
Expenses incurred at 1914 Convention	594.35
Printing programs and invitations	60.10
Subscriptions to magazines	18.10
Membership certificates	77.55
Brought forward	$3,947.75

Disbursements carried forward	$3,947.75	
Expenses of Standing Committees	163.70	
Donation to Forest Prod. Expo. Com.	224.59	
Expense of Bulletin	597.04	
		$4.933.08
Cash on hand December 31. 1914		$737.16

DETAIL STATEMENT OF WOOD-PRESERVERS' BULLETIN.

Receipts.

Subscriptions (cash received)	$ 33.00	
Advertising (cash received)	33.00	
Advertising (due December 31, 1914, but not paid)	100.67	
		$166.67

Disbursements.

Printing (four issues)	$349.25	
Postage	31.83	
Stationery	50.96	
		597.04
Deficit		$430.37

Membership.

Number of members last annual report			183
Number of members elected during year 1914		90	
Number of members reinstated		2	
		92	
Number of members resigned	4		
Number of members dropped	3		
Number of members deceased	3		
		— 10	
Total net gain		—	82
Number of members in good standing Dec. 31, 1914			265
Number of Corporate members	211 or 79.6%		
Number of Associate members	50 or 18.9%		
Number of Honorary members	4 or 1.5%		
	265		

Growth of Membership.

Year.	New Members.	Withdrew.	Added to Roll.	Total.
1904	20	..	20	20
1905	7	..	7	27
1906	9	7	2	29
1907	15	..	15	44
1908	5	4	1	45
1909	13	12	1	46
1910	29	8	21	67
1911	45	8	37	104
1912	59	6	53	157
1913	37	11	26	183
1914	92	10	82	265
Total	331	66	265	265
Average for 11 years......	29.8	6	23.8	

Distribution of Membership.

	Members.
38 Railroads	75
45 Commercial treating plants............................	99
12 Tie and lumber companies............................	12
22 Chemical and manufacturing concerns.................	34
2 Periodicals	2
3 Wood block paving associations......................	4
3 Educational institutions............................	5
5 Firms not classified................................	5
3 Municipalities	3
Individuals not classified..............................	9
Consulting engineers and chemists.......................	12
U. S. Forest Service....................................	5
Total	265

Geographical Distribution of Membership.

State.	1913.	1914.	State.	1913.	1914.
Alabama	3	4	Georgia	3	2
Arkansas	4	5	Illinois	27	35
California	4	5	Indiana	5	6
Colorado	0	3	Iowa	1	2
Connecticut	1	1	Kansas	1	4
District of Columbia...	0	4	Kentucky	3	7
Florida	4	4	Louisiana	8	10

Geographical Distribution of Membership—(Continued).

Maryland	6	5
Massachusetts	1	2
Michigan	3	2
Minnesota	10	9
Mississippi	3	3
Missouri	8	12
New Jersey	3	7
New Mexico	2	3
New York	11	21
Ohio	11	11
Oregon	4	7
Pennsylvania	9	14
Tennessee	1	3
Texas	13	17
Virginia	3	3
Washington	9	16
West Virginia	2	2
Wisconsin	6	8
Wyoming	1	3
	170	240
Foreign Countries.		
Austria	1	1
Canada	8	14
England	2	4
Germany	2	6
	183	265

Respectfully submitted,

(Signed) F. J. ANGIER,

Secretary-Treasurer.

THE PRESIDENT: We will hear the communications the Secretary has received.

Secretary Angier then read communications from Mr. Graves, U. S. Forester; William L. Hall, Assistant U. S. Forester; Mr. Gifford Pinchot; Mr. George W. Tillson, Consulting Engineer of the City of New York; Mr. F. B. Ridgway, Third Vice-President of the Association; Mr. R. S. Manley, Second Vice-President, and Mr. R. Kellogg, Treasurer of the Forest Products Federation, as follows:

Communications.

Washington, January 8, 1915.

Dear Mr. Angier:

Let me thank you for your letter of January 6 and your cordial invitation to attend the annual convention of your Association in Chicago on January 19-21. I am sorry that it will be impossible for me to accept this invitation, as I have a previous engagement in the East at that time. It is very probable, however, that a representative of the Laboratory will be present at the meeting.

With best wishes for the success of your meeting, I am,

Very sincerely yours,

H. S. GRAVES,

Forester.

U. S. Dept. of Agriculture, Forest Service.

Washington, January 8, 1915.

Dear Mr. Angier:

I desire to make acknowledgment of your very unique and interesting invitation to attend the meeting of the American Wood Preservers' Association January 19 to 21. I should like very much to be there, but it will hardly be possible for me to do so.

I am very glad to know that the Association is to visit the Madison Laboratory. It has been a source of very great satisfaction to me to know that the Laboratory has served so usefully in solving the problems which concern the various wood-using industries.

Wishing you a very successful meeting, I am,

Very sincerely yours,
WM. L. HALL,
Assistant Forester,
U. S. Dept. of Agriculture, Forest Service.

Philadelphia, January 11, 1915.

My Dear Sir:

Your letter of January 5 with its kind invitation to address the Annual Convention of the American Wood Preservers' Association is received in Mr. Pinchot's absence. He is, at present, en route to Europe and, therefore, cannot accept.

With much regret,

Sincerely yours,
P. S. STAHLNECKER,
Secretary to Gifford Pinchot.

Brooklyn, N. Y., December 28, 1914.

Mr. H. L. Collier,
Chairman Publicity Committee,
American Wood Preservers' Ass'n,
St. Louis, Mo.

Dear Sir:

I am in receipt of yours of the 22nd inst., in regard to the meeting of the American Wood Preservers' Association, to be held in Chicago in January next.

I should be very glad indeed to be present, as I am very much interested in the general subject. I am, however, just back from a road convention in Chicago, so that it will not be possible for me to go there again so soon.

Thanking you, however, for calling my attention to the matter,

Very truly yours,
GEO. W. TILLSON,
Consulting Engineer,

Office of President of the Borough of Brooklyn.
Atlantic City, N. J., January 18, 1915.

American Wood Preservers' Ass'n,
F. J. Angier, Secretary-Treasurer,
Congress Hotel, Chicago, Ill.

Regret inability to be with you. Very best wishes for a most successful meeting.

F. B. RIDGWAY.

New Orleans, La., Jan. 13, 1915.

Dear Sir:

I am very sorry to inform you that certain matters have arisen that will make it impossible for me to attend the Convention this year.

I regret this very much, as I have counted very much on attending this Convention, and believe that we are going to have one of the best Conventions in the history of the Association.

Will you kindly express to the others on the Executive Committee my regrets in this matter?

Yours very truly,
R. S. MANLEY,
Second Vice-President A. W. P. A.

Copenhagen, Jan. 22, 1915 (Via. Postal), Chicago, Jan. 22, 1915.

Rex,
Topeka.

Best wishes for successful meeting and greeting.

(Signed) KUCKUCK.

[This cablegram from Berthold Kuckuck was received too late to be read at the Convention.]

Chicago, January 18, 1915.

Secretary,
American Wood Preservers' Ass'n,
Chicago, Ill.

Dear Sir:

No doubt you have already arranged to bring the work of the Forest Products Federation to the attention of your members. It is an undertaking that means much for the promotion of the use of wood and is receiving the hearty co-operation of all branches of the trade.

The preparation of the program for the mass meeting is going forward along the lines indicated in the enclosed statement, and I am for-

warding to you under separate cover some invitation slips which I hope you will kindly put into the hands of the members present at your meeting this week.

Very truly yours,
R. S. KELLOGG.
Treasurer.

[The statement referred to by Mr. Kellogg relates to the appointment of committees to have full charge of arrangements and to prepare reports on Building Codes, Fire Losses, Comparative Prices of Building Material, Shingles, and Promotion, which will be presented at the Convention of the Forest Products Federation.]

THE PRESIDENT: Mr. Sterling, have you any remarks to make at this time in regard to this communication we have received from Mr. Kellogg?

MR. E. A. STERLING: I do not know that it is necessary at the present time, Mr. President. I may simply corroborate what was said there to the effect that all branches of the lumber trade, including the manufacturers and distributors, are planning a very large and important mass meeting in Chicago on February 24 and 25. Plans will probably be made for the definite promotion of the lumber industry. The lumbermen feel that the promotion of treated material is essential, so it is a matter of importance to the American Wood Preservers' Association, and they should take a very keen interest in this movement. There will be a good opportunity for co-operation.

Program

TUESDAY FORENOON.

1. President's Address.
2. Report of the Secretary-Treasurer.

Plant Operation and Miscellaneous.

3. Report of Standing Committee on Plant Operation.
4. Economical Use of Steam in Connection with Wood-Preserving Plants, by A. M. Lockett.
5. Discussion on Plant Operation, by Samuel T. Pollock.
6. Strength and Quality of Zinc Chloride Per Tie or Per Cubic Foot of Timber, by W. F. Goltra.
7. Discussion on the Economical Use of Steam, by M. K. Trumbull.

TUESDAY AFTERNOON.

Plant Operation and Miscellaneous (Continued).

8. Discussion on Leaching of Zinc Salts and Effects of Improper Drainage, by F. J. Angier.
9. Some Suggestions for the Welfare of the Association, by Chas. C. Schnatterbeck.

10. Temperature Changes in Wood Under Treatment, by George M. Hunt.
11. Discussion on Temperature Changes in Wood Under Treatment, by H. M. Rollins.
12. Discussion on Steaming Ties, by J. B. Card.
13. Report of Standing Committee on Miscellaneous Subjects.

Ties, Timbers, Piling and Cross-Arms.

14. The Final Inspection of Timber, by C. M. Taylor.

WEDNESDAY FORENOON.

Preservatives and Specifications.

15. Report of Standing Committee on Preservatives.

Ties, Timbers, Piling and Cross-Arms (Continued).

16. A Voice From the Pacific Coast, by H. E. Horrocks.

Preservatives and Specifications (Continued).

17. A Specification for a Coal-Tar Creosote Solution, by Dr. Hermann von Schrenk and Alfred L. Kammerer.
18. Discussion on a Specification for a Coal-Tar Creosote Solution, by V. K. Hendricks.
19. Discussion on a Specification for a Coal-Tar Creosote Solution, by P. C. Reilly.
20. Discussion on a Specification for Creosote Oil, by J. C. Williams.

Ties, Timbers, Piling and Cross-Arms (Continued).

21. Air Seasoning of Cross Ties, by A. H. Noyes.
22. Method of Buying and Inspecting Ties Produced Along the Right of Way, by W. F. Goltra.
23. Discussion on Air Seasoning of Cross Ties, by Samuel J. Record.
24. Discussion on Air Seasoning of Cross Ties, by Wm. A. Fisher.

WEDNESDAY AFTERNOON.

Ties, Timbers, Piling and Cross-Arms (Continued).

25. A Method for Finding the Annual Charges for Ties, by Harrington Emerson and T. T. Bower.
26. Discussion on a Method for Finding the Annual Charges for Ties, by V. K. Hendricks.
27. The Mechanical Life of Ties as Affected by Ballast, by E. Stimson.
28. Additional Facts on Treated Ties, by J. H. Waterman.
29. Treated Timber for Factory Construction (illustrated by stereopticon views), by F. J. Hoxie.

Preservatives and Specifications (Continued).

30. The Comparative Toxicity of Coal-Tar Creosote and Creosote Distillates and of Individual Constituents for the Marine Wood Borer, Xylotrya (illustrated by stereopticon views), by Dr. L. F. Shackell.
31. Report of Standing Committee on Specifications for the Purchase and Preservation of Treatable Timber.

THURSDAY FORENOON.

Ties, Timbers, Piling and Cross-Arms (Continued).

32. Sill Ties, by F. J. Angier.
33. Discussion on Sill Ties, by Samuel T. Pollock.
34. Discussion on Sill Ties, by Harrington Emerson.
35. Destruction of Timber by Marine Borers, by E. S. Christian.

36. Discussion on Destruction of Timber by Marine Borers, by J. C. Williams.
37. Attack of Marine Borers on Creosoted Material, by T. G. Townsend.

Wood Block Paving.

38. Laboratory Analysis After Treatment Versus Actual Record During Treatment of Creosoted Wood Paving Blocks, by Frank W. Cherrington.
39. Report of Standing Committee on Wood Block Paving.
40. Discussion on Report on Wood Block Paving, by E. R. Dutton.
41. The Bleeding and Swelling of Paving Blocks, by Clyde H. Teesdale.
42. Discussion on Bleeding and Swelling of Wood Block Pavements, by L. E. Hess.
43. Discussion on the Bleeding and Swelling of Paving Blocks, by E. R. Dutton.

Business Session.

Report of Committee on Constitution and By-Laws.
Report of Committee on Resolutions.
Election of Officers.

THE PRESIDENT: Before we go further, I would like to make an announcement, a little unusual, but Dr. von Schrenk would like to have the members of the Timber Committee of the American Society for Testing Materials meet in this room after our session this afternoon.

We will appoint an Auditing Committee consisting of Mr. Goltra and Mr. Ford.

We will appoint a Nominating Committee consisting of Mr. Lowry Smith, Mr. Rollins, Mr. Larkins, Mr. Taylor and Mr. G. B. Shipley. For the Committee on Resolutions I will appoint Mr. Foley, Mr. L. B. Shipley, Mr. Waterman, Mr. Trumbull and Mr. Cooper.

MR. J. H. WATERMAN: Mr. President, you practically have the same Committee on Resolutions this year that you had last year. You ought to give some of us fellows a rest.

THE PRESIDENT: I think the Committee on Resolutions did excellent work last year and they do not look like they are overworked now. If Mr. Davidson is in the room we will have him report at this time.

MR. G. M. DAVIDSON: Your Entertainment Committee offers the following: For the gentlemen—Wednesday evening, a banquet; business clothes. Thursday afternoon, visit to the Field Museum to view an exhibition of several hundred specimens of various kinds of woods and other things of interest under the personal guidance of officers of the museum. On Friday, the day following the adjournment of the Convention, the Entertainment Committee has arranged for an excursion to Madison, Wis., to visit the U. S. Forest Products Laboratory and the University of Wisconsin. At the Forest Products Laboratory many things of special interest to Wood Preservers will be shown. At the University of Wisconsin there will be an exhibition of moving pictures. Madison is located 130 miles from Chicago, in one of the most

famous lake regions of Wisconsin. The main portion of the city lies between two large lakes. Ice-boating is a popular winter sport. The members and their guests will be afforded the opportunity of being participants or spectators of this pastime.

For the ladies the Entertainment Committee has arranged visits to the large stores in Chicago and a complimentary luncheon at Marshall Field & Co.; a visit to the Art Institute and a complimentary luncheon at the College Inn, where an exhibition of fancy skating will be given on an artificial ice rink located inside the Inn and surrounded by lunch tables; complimentary theater party at a leading theater; complimentary visit to Field Museum with the gentlemen, and the ladies are also invited to visit Madison, Wis., with the gentlemen. [The Entertainment Committee consisted of Geo. M. Davidson (Chairman), W. T. Watkins, M. K. Trumbull, A. H. Noyes, Geo. L. Pollock, Frank D. Fenn and J. B. Card.]

THE PRESIDENT: It would be needless for Wood Preservers knowing the personnel of the Entertainment Committee to say that they have done their work well, yet I cannot resist the temptation of especially thanking the Entertainment Committee this year for the magnificent work and support they have given us. I would like especially to say that every member of the wood-preserving industry ought to take advantage of this trip to Madison, where in one day we will have an opportunity to see the development of the problems that we are all working on. I know that none of you could spend a day's time or as little effort and derive as much benefit from it as from this trip to Madison, and I hope you will all see fit to attend.

By dispensing with the earlier portion of the program we are able to accomplish some of the things that we wanted to do. We will, therefore, have the report of Standing Committee No. 4 on Plant Operation this morning, Mr. H. M. Rollins, Chairman.

MR. H. M. ROLLINS: It is pretty hard to do committee work, where there are a good many committees operating, in a way that committee reports will not overlap, and in the report of the Committee on Plant Operation you will very likely find subjects taken up that you may think properly belong in the reports of other committees. The Committee on Plant Operation felt that it is justified in making the insertions in this report. I will read the report of this committee:

REPORT OF COMMITTEE ON PLANT OPERATION.

To the Members of the American Wood Preservers' Association:

In line with instructions issued by the Executive Committee to the Committee On Plant Operation, we, the said Committee, beg to submit the following report:

Concerning that part of your instructions referring to "The Economical Consumption Of Steam In Treating Plants" beg to advise, that to properly cover this subject, required more time than was at the disposal of any member of this Committee; but that Mr. A. M. Lockett of New Orleans, has prepared a paper covering this subject.

In further compliance with your instructions, we have compiled a list which we believe represents standards of practice in plant operation.

Plant operation includes all that multitude of details of the handling of Materials, Preservatives, Labor, Fuel, Inspection, and Equipment, necessary to produce a properly treated product.

This Committee appreciates the magnitude of the responsibility it assumes, when it undertakes to outline and recommend for adoption, certain practices as the standard of this Association.

Preservatives.

Creosote.—That the term Creosote be used only to apply to, and designate a pure and unadulterated distillate of a pure coal tar; that the application of this term to a mixture of Creosote with any other substance, such as Tar, Tar Oils, Petroleum, or any of its derivatives, or to any of these singly, or to any other substances, is misleading, bad practice, and not in accordance with the ethics and ideals of this Association.

Determination of the Amount of Oil Injected.—That the old method of a float gauge be recognized as a standard method for determining the amount of oil injected into a charge of material, the last tank reading shall be converted, by correction for temperature, into a reading corresponding with the temperature of the first reading, and the difference between the first gauge reading and the corrected last gauge reading, will represent the tank feet of fractions thereof injected into the charge, and the weight of oil injected to be determined from this difference as represented in tank feet, taking the weight of oil at 38°C as a basis from which and to which to work, allowing a variation in volume of the oil of 1 per cent for each 22½° F difference in temperature.

Determination of Specific Gravity.—Should the temperature of the oil be below 38° C, it shall be heated to a temperature of 45° to 50° C and then allowed to cool to 38° C, at which temperature the hydrometer reading should be taken; if above 38° C it shall be cooled down to 38° C as noted above; the hydrometer for this work should be one reading Specific Gravity direct at a temperature of 38° C.

Working Temperature.—Oil in working tank should have a temperature of not less than 150° F and not more than 190° F, when introduced into treating cylinder.

Fractionation of Creosote.—That a Hemple flask or a 250 CC retort, complying with the specifications of this Association be used for this work.

That a fractionation, to be in accordance with standard practice, must be done with the standard apparatus specified by this Association, assembled in accordance with the specifications for this work.

That a fractionation commences the instant the first drop of distillate appears in the condensing tube, the distillation must be carried forward at the rate of one or two drops per second, and is a continuous operation at this rate from the time of the appearance of the first drop of distillate in the condensing tube until the maximum temperature is reached, that the beakers, or other receiving vessels for the different fractions, be replaced at the end of the condensing tube, the instant the thermometer indicates the maximum temperature for that fraction, by the vessel intended to receive the next higher fraction, the vessel receiving the last fraction to be removed the instant the maximum temperature is reached, and that any distillate coming over after the vessel receiving the last fraction has been removed, be collected and returned to the retort or flask, and weighed as residue.

Zinc Chloride.

When received at plant in fused form zinc chloride should be stored in as dry a place as practicable.

Preparation of Solution.—The fused chloride shall be put into a small vat, or tank, preferably of steel construction, and water added until same is converted into a concentrated solution, about a 50% solution, this to be added to solution in working tank as needed.

Amount of Chloride to be Injected.—Since established records, supplemented with laboratory tests, indicate that one-half pound of dry Chloride of Zinc per cubic foot of timber is essential to insure proper protection against decay the use of smaller quantities is not considered standard practice.

Uniformity of Solution.—Since best results are obtained in zinc chloride treatment, when the solution is maintained at an even strength in all parts of the working tank, it is essential that proper provision be made for keeping the working solution well mixed.

Amount of Solution to be Injected.—It shall be recognized as standard practice, to treat all material, treated with zinc chloride solution, to refusal; the strength of solution being so manipulated, that the required amount of dry chloride of zinc per cubic foot of material will be injected.

Seasoning of Material.

Ties.—When stored at plant for seasoning, ties should be stacked on treated sill ties, with ample provision being made for air circulation

through and between the stacks. It is not good practice to stack ties in a yard that is not properly drained, nor is it good practice to stack them on wholly or partially decayed timber, nor is it good practice to leave pieces of decaying timber promiscuously scattered about a tie yard or treating plant. Green ties should not be stacked in the same stack with more or less seasoned ties.

Piling.—When stored at plant for seasoning, should have sufficient air space left between the tiers to insure good circulation; before being stacked any bark remaining on piling should be removed, and a piling may be considered as being properly peeled, only, when not more than ten per cent of the surface of the stick remains covered with the inner skin, and when this inner skin does not appear in larger areas than one half inch wide and six inches long.

Structural Timbers—Aside from proper seasoning, it shall be standard practice to frame all timbers, as far as is possible, before treatment.

Poles.—Peeling and seasoning as suggested for piling to apply to poles, and in addition, all roofing, gaining, and boring of holes should be done before treatment.

Paving Block Stock.—If stored at plant should be so stacked, that air may circulate freely between all the planks in the stack, and so that water from rains and storms will drain off the lumber, however. considerable lumber loss due to checking and weathering of material. when same is air seasoned, can be avoided, by converting the lumber into blocks soon after its arrival at the treating plant, and treating same either in a green or semi-seasoned state. The record of service of wood block pavement does not indicate that blocks made from seasoned material give any better service than those made from green or partially seasoned material; and it shall be considered standard practice to manufacture paving blocks from either seasoned stock, or green or partially seasoned stock.

Equipment.

Equipment in general is without the sphere of this Committee's duties, but we suggest the following as being necessary for an operator to operate in accordance with standard practice:

Recording vacuum and pressure gauges for treating cylinder.

Recording thermometers for treating cylinders.

Sufficient boiler power to handle the maximum load with ease.

Covering or roofing for creosote tanks.

Some apparatus for weighing boiler feed water, Fuel Ash, etc., necessary to keep a check on boiler plant.

Labor.

That wherever possible to arrive at a unit base from which to

work, all handling of material at a treating plant should be done at a fixed price per unit.

Treatment.

In treating green or unseasoned timbers, piling, ties, etc., it shall be considered good practice to steam this class of material, by the direct application of live steam to the material in the treating cylinder, for varying periods of time, and at temperatures varying in accordance with the condition, kind and size of timber; but in no case to exceed a maximum temperature of 280° F; steaming to be followed by a vacuum of not less than twenty-two inches, temperature in cylinder being maintained at as high a point as possible during time of vacuum.

Storage of Treated Material at Plant.

Material treated with Creosote; inasmuch as general tests and observation indicate and prove, that Creosote evaporates rapidly from freshly treated material, it should no longer be considered good practice to stack creosoted material in open stacks, which does of necessity accelerate the evaporation of large quantities of oil, but on the other hand creosoted material should be stacked in close piles to prevent this oil loss, and to prevent destruction by fire, as material piled closely permits of no fire circulation through the pile.

Material treated with zinc chloride, should be stacked openly to facilitate the evaporation of water injected during treatment.

H. M. ROLLINS, *Chairman.*
C. D. BATSON,
F. H. STEWART,
A. M. SMITH.

THE PRESIDENT: We are going to defer the discussion of this committee report until we hear the next paper on the program. We have the pleasure of having with us this morning one of our distinguished Southern engineers, Mr. Lockett. We will ask Mr. Lockett to read his paper, and then we will take up the whole subject of plant operation in one discussion.

Mr. A. M. Lockett then read his paper as follows:

ECONOMICAL USE OF STEAM IN CONNECTION WITH WOOD-PRESERVING PLANTS.

By A. M. Lockett.

I feel some embarrassment in undertaking to offer to this Convention a paper containing advice as to how a wood preserving plant should be operated, because while I have given the subject considerable study I have had no experience in the actual operation of such a plant.

It is, however, not outside the bounds of possibility that having visited a great number of wood preserving plants and studied the designs upon which these plants were constructed as well as the basis upon which they were operated, I may be able to offer some suggestions which might be worth while.

From the standpoint of an engineer interested in the general proposition of steam plant economy it has seemed to me that the managers of most of the wood preserving plants visited by me, are so intent upon maintaining the maximum output that the question of steam economy has not received the attention to which it is entitled.

While, no doubt, in this particular business. the volume of output is of the first importance, economy in steam consumption should not be entirely overlooked, even if volume of output were the sole consideration, since the proper attention to this item would, in many cases, increase the output not to mention the actual saving in cost per unit of output

At the risk of exciting amusement at the simplicity of the obvious truth of the statements I am about to make, I wish to call attention to some fundamental facts bearing upon the steam consumption of a plant.

You cannot perform any work without the consumption of something, whether it be of human vitality in the case of manual labor or of steam in the case of steam operated machinery.

The quantity of this something consumed depends upon the amount of work accomplished and the efficiency with which that work is performed.

Manifestly, therefore, the first step towards economy in the use of steam is to reduce to the minimum the amount of work done by the steam consuming machinery and the second consideration is to increase to the maximum the efficiency of the machine performing the work.

The only kind of work which adds to the value of the thing produced is the useful work and any unnecessary work is a pure and simple expense which is without value to anyone.

The cost to pump water, or any other liquid, is in direct proportion to the quantity pumped, and to the pressure against which the liquid is delivered. If, therefore, we pump more of this liquid than is necessary for our purpose and if we pump this liquid against a pressure greater than that required, we consume an unnecesary quantity of steam disregarding for the moment the effect upon the steam consumption which the condition of the machine itself has.

The quantity of steam consumed in compressing air depends upon the volume of air handled and the pressure against which the air is

delivered. Therefore, we should make sure there are no air leaks and that we carry no higher pressure than is actually required.

The exhausting of air from a retort by an air pump consumes steam in proportion to the quantity of air handled and the difference in pressure inside and outside of the retort. Therefore, we should have no leaks through which air can enter the retorts and the vacuum should be no greater than the treatment calls for.

The lifting of loads by hoisting apparatus costs in proportion to the weight lifted and the distance through which it is lifted. Therefore, if we must handle these weights we should be careful not to hoist them to unnecessary heights.

The cost of hauling loads upon horizontal tracks depends upon the weight hauled and the distance hauled, and there should be no unnecessary distance covered.

There is not a member of this Convention who could not improve the steam consumption of his plant by giving the proper attention to these simple facts, but I wish to undertake, before concluding, to make some specific recommendations which occur to me.

The subject of my paper is "The Economical Use of Steam in Connection with Wood Preserving Plants," but I shall understand this topic to really be "The Economical Use of Fuel," since a paper of this kind would not be complete without going back to the coal pile.

In order to handle my subject in a systematic manner and to have you understand the basis of my reasoning, I think it would be well to first describe to you my understanding of the theory underlying the design of wood preserving plants.

The process stated briefly is, to remove from the timber the sap, the moisture and the air contained therein and to substitute therefor in varying quantities, creosote oil or some other preservative.

As my study of this subject has been confined entirely to the creosoting process I will not undertake to discuss any other type of plant.

If the timber which is to be treated is air seasoned the process would consist of enclosing the timber in the retort, creating a vacuum for the purpose of removing the air and then introducing the oil.

Due to the great demand for treated timber and to the inability to secure air dried materials it is usually necessary to remove the moisture and sap by artificial means.

The timber is introduced into the retort and is there subjected to heat by the admission of steam.

The heat of the steam is transferred to the wood by the condesation of the steam.

I believe that the principal, if not the only useful function performed by the steam is to increase the temperature of the wood and

the contained moisture until it will have reached the temperature of the steam.

It is impossible that any evaporation or removal of moisture can take place while the steaming process is in operation.

As a matter of fact the condensation of the steam in the pores and upon the surface of the wood increases temporarily very greatly the amount of moisture present, and if one could examine the interior of the retort during this stage of the process he would find the condition of the wood almost equal to that which would exist were the wood submerged in water.

When the timber and the contained moisture will have reached a temperature equal to that of the steam, the pressure is released, the steam blown off and the retort immediately subjected to vacuum.

As you know there is a temperature corresponding to any given pressure of steam, and any water in contact with the steam under this pressure is of the same temperature.

While the temperature of the water and the steam are the same, the total heat in the steam is very much greater due to the latent heat necessary to convert the liquid into vapor.

If, in a vessel containing water and steam under pressure the pressure is reduced the water contains more heat than it can retain at this reduced pressure and necessarily some of the water evaporates.

As soon as the pressure is removed from the retort the heat contained in the wood and moisture immediately causes violent evaporation, and as the pressure is still further reduced by the creation of a vacuum this evaporation becomes more intense.

There is probably not in the timber, the water and this moisture sufficient heat to furnish the latent heat necessary to transform all of the liquid content into a vapor and I do not believe that all of the moisture is evaporated, but it is probable that the violent ebullition which takes place in the interior of the wood furnishes sufficient vapor to push before it the liquid which has not been evaporated, and in this way the wood is rendered comparatively free from moisture.

The moisture and air having been removed by the vacuum process the wood is then ready for the introduction of the oil..

In wood preserving plants steam is used for the following purposes:

Heating the timber in the retorts,
Heating the oil in the retorts,
Heating the oil in the storage tanks,
Heating the buildings in winter,
Generating power for cranes, etc.,
Operating pumps, air compressors and other auxiliaries.

There seems to be a common impression among the employees of these plants that so long as the boilers are there and capable of

furnishing steam no special care need be exercised in the use of this steam.

It would be just as sensible for employees of any establishment to take the position that so long as there is plenty of money in the safe in the office there is no good reason why this money should not be expended freely.

The steam in your boilers is just as much money as the actual coin in your safe and it should not be used with any less care.

In this day it is quite usual for operators of industrial establishments to enlist the services of what is known as "efficiency engineers" and while unfortunately there are many men professing to be "efficiency engineers" who are not able to make good, there are competent men doing this class of work who can be of great value to operators of wood preserving plants.

If you should employ such a man he would, no doubt, begin his investigation at your coal pile and while not professing to be an expert in this line, I shall, myself, follow this method.

A pound of coal or any other fuel, is valuable to you directly in proportion to the heat it will give off when burned. One pound of coal is said to contain so many heat units when burned, and it is your duty to yourself to as nearly as practicable see that every unit of heat which is given off by the coal burned in the furnace of your boiler does useful work.

It is, of course, not possible to prevent certain losses, but it is not only possible but quite practicable to prevent the majority of losses which take place in plants making use of steam.

When the coal is burned in the furnace you wish to transfer the heat to the water contained in the boiler and to generate the steam.

In many of the plants some of the combustible ingredients of the coal are not even burned due to the type of furnace not being suitable for the particular fuel used, to unsuitable grates and to insufficient draft.

It is a very simple matter to analyze the gases passing from your furnace and to determine from such analysis whether complete combustion is taking place and by inspection of your furnace to determine why, if the combustion is not up to the standard, that the proper remedy may be applied.

Assuming that your furnace is doing its duty and that the combustibles in the fuel are actually being burned and the heat generated, it is the function of your boiler to absorb as much of this heat as is practicable and transfer it to the water contained in the boiler.

While the efficiency of the boiler depends greatly upon the ar-

rangement of its heat absorbing surfaces and its general design bearing upon the circulation of the water and the path of the gases, the principal source of loss of heat in a steam boiler plant is the condition of the heating surface with reference to accumulation of soot one one side and scale upon the other side.

It has been shown quite conclusively that a scale of 1-16" in thickness will increase the loss of heat in a boiler by probably 20 per cent. not to mention the reduction in the capacity of the boiler which in case of wood preserving plants may seriously prolong the process and as a consequence curtail your output.

The accumulation of soot on the fire side of the heating surface might easily cause very serious losses.

It is, therefore, of paramount importance that the heating surface of your boilers be kept thoroughly clean; and no plant manager should fail to personally inspect the condition of his boilers at frequent intervals to make sure that this is done.

Now, assuming that you have put your boiler furnace and your boilers into such condition as to generate steam efficiently, let us trace this steam as it leaves the boiler and point out losses that occur.

The moment the steam passes into the header or main steam pipe it begins to part with its heat, by reason of the fact that the air outside is much colder than steam.

If the pipe is not properly covered by a suitable non-conductor, this loss is a very serious matter.

This loss is sufficient to justify the expense of covering every square inch of pipe carrying steam and all valves and fittings which are under live steam pressure; and if any of you have any uncovered pipes in your plant, you should certainly give the covering of them your immediate attention.

When the steam is admitted into your retort its first duty is to heat the retort itself, and in doing this a tremendous quantity of heat is required. It is probable that the preventable losses by radiation from a retort 7x120' will equal 50 boiler horse power.

During the whole process of steaming the wood, the surfaces of the retort are rapidly radiating heat and consuming steam; therefore, all retorts used in this process should be properly protected by suitable non-conducting material.

It goes without saying that all steam leaks should be promptly stopped; but having seen plants where a number of steam leaks exist without apparently giving the plant managers any concern, I think it is not out of place to mention this because some of you might not realize the great expense a number of such leaks will entail, although each one of them might be trifling in itself.

One of the machines in the creosoting plant which requires a considerable quantity of steam to operate and which frequently uses very much more steam than is necessary, is your air pump.

I have been surprised to find that frequently treating plant managers are not aware of the fact that they have a condensing proposition in the creation and maintaining a vacuum upon the retort. They apparently think that the vacuum is created by the air pump actually removing the vapor and air by displacement, and in some plants this is practically what takes place.

After the steam is first blown down from a retort, not only is the retort full of steam, but there is a rapid evaporation of the moisture in the wood. Therefore, at this time there is need of a very substantial condenser to condense those vapors which are capable of being condensed, in order that the work upon the air pump may be only that for which it is legitimately intended.

Some of the vapors and, of course, all of the air in the retort are not capable of being condensed by ordinary means, but the largest part of these vapors can be quickly condensed by merely bringing them in contact with a spray of water. If there is an ample quantity of water the condensable vapors are almost instantly condensed and the air pump only removes those vapors and the air which cannot be condensed.

If there is not a sufficient quantity of water the air pump is called upon to bail out the steam and vapors by actual displacement requiring not only a large quantity of steam to drive the condenser, but also delaying very much the creation of the desired vacuum.

I recall an instance where in a treating plant of large capacity the water available for condensing was only that which would enter through a 1¼" pipe lead from an elevated tank.

In this plant it ordinarily required two hours to create the proper vacuum, although they had an air pump with a piston 22" diameter and a stroke 24" long.

By increasing the water pipe to 3" it was quite easy to create the required vacuum in twenty minutes. If this plant could estimate the loss which it had sustained by reason of this improper condensing apparatus during the period of years it had been operated, I venture to say that the amount would run into many thousands of dollars in actual quantity of steam used, not to mention the curtailment of output of the plant.

I have observed in many creosoting plants that steam traps are not used upon heating coils, dependence being placed on the drainage of these coils by use of a valve; and in most cases these valves are improperly regulated, so that there is a constant waste of steam, whereas with an automatic trap no steam whatever will pass through.

There are many plants being operated today using live steam in places where exhaust steam would serve the purpose just as well. I refer to the heating of oil in tanks and to the heating of plants and offices in the winter.

There is usually sufficient exhaust steam available at all times from the air compressors, pumps and engines to do all this heating with steam which would be otherwise thrown away.

I have noticed in some plants that the entire water supply is pumped to an elevated tank, and water from the elevated tank brought down to the surface again for use in the condenser, when the condenser would operate just as well with water which has not been previously pumped. A low service pump operated in conjunction with the condenser would be necessary in starting the condenser; but after the vacuum is created the condenser will lift its water to a moderate height without the use of any pump whatever. These remarks apply to the ordinary jet type of condenser and not to the barometric jet nor surface condensers.

In plants where pulling and hoisting steam engines are located in the yards remote from the boiler plant, the steam supply pipes are rarely ever properly covered; and not only is there a tremendous waste of steam, but serious injury to the engine takes place due to water in the pipe and the interference with the proper lubrication of the engine by the presence of this water.

A great waste of steam takes place frequently by reason of bad condition of valves and pistons on the water ends of pumps. So long as the pump is maintaining the desired pressure, it requires just as much steam to force the water by leaky pistons and through leaky valves as it does to force this water into the boilers or into the tanks, whichever the case may be. The same thing applies to pumps used for handling the creosote oils.

A large quantity of steam is also wasted on account of insufficient cylinder lubrication of steam pumps from leaky steam piston rings and leaky slide valves.

I venture to say that in some plants which are apparently well conducted, the steam consumption of the pumps is twice what it ought to be, on account of the condition of the pumps.

This same criticism applies to air compressors, electric light engines, and other steam-using machinery.

The heating of feed water by exhaust steam is a very direct and positive way to save fuel. All plants have heaters, but due to the fact that at the time the retort is under steam, at which time there is the maximum demand for steam, many of the auxiliaries are shut down and frequently there is not enough exhaust steam available

to heat the water to the proper temperature. Not only can a substantial saving in fuel be made, but greater boiler capacity obtained by using a large, covered and closed tank as an accumulator of hot water, this water being heated during the time that there is a surplus of exhaust steam.

I have before me, while preparing this paper, the report of a 24 hour boiler test made at a wood preserving plant from the log of which some very interesting facts were brought out.

The plant was equipped with a boiler of 200 nominal horsepower.

The load on this boiler varied from 161 horsepower to 401 horsepower. The average for the first 18½ hours was 306 horsepower or 150 per cent. of rating. During the last 5½ hours the load fell off bringing the average for 24 hours down to 268 horsepower or 34 per cent. above the nominal horsepower. In accordance with the recommendation of the engineer who conducted the test a 300 horsepower boiler was substituted for the 200 horsepower, a stack one hundred feet high giving ample draft was installed and some other changes were made, the need of which was apparent from this test. By these changes the output of the plant was increased 33 per cent., and the total quantity of coal consumed was actually reduced.

A test of one of these plants for a period of twenty-four hours conducted by a competent engineer would give most valuable information upon which you could determine whether your boilers are ample in capacity, whether they are being operated efficiently, whether you are using excessive quantities of steam in operating your machinery and result in pointing out ways and means by which the steam consumption can be so much reduced that the fee of the engineer would be a most profitable investment.

THE PRESIDENT: The expenses of our industry are made up of these three items: Preservatives, labor and fuel. While each man operating a treating plant will readily say that we devote no end of time and energy to the checking of waste in both preservatives and labor, I venture to say that few of us have given a great amount of thought to the saving of fuel, one of our large items of expense and I believe one of the items of expense that we can do more towards reducing by the competent management of our boiler plant than on any other item of treating plant operation. I was, therefore, greatly pleased to have Mr. Lockett, who is one of our well known consulting engineers in the steam industry in the South, present this paper in connection with Committee Report No. 4 on Plant Operation. We will consider the paper and the report of the committee together.

Before beginning these committee reports and discussions thereon I would just like to say that this Association has gotten to a point wher

we expect to publish a manual on our best practices, and in order to do so we have got to have a full expression of every member of our Association. While it is sometimes unpleasant to express disapproval of another man's views, yet it is only by that means that we arrive at the correct and unified expression of our Association. I hope each member will feel a personal obligation to add anything to these discussions that he can. We have asked Mr. Crawford to make a few remarks to start the discussion.

MR. CARL G. CRAWFORD: I have been asked to start the discussion on the report which has just been presented. One of the first things the committee takes up in their report is a definition of plant operation, and I think we might well devote a few minutes to this definition, in order that we may know what we are talking about.

Our Committee has described it as "a multitude of details of the handling of materials, preservatives, labor, fuel, inspection and equipment necessary to produce a properly treated product." I have but little criticism or comment to make regarding this definition, but to me the Committee has not followed its own definition. I should like, however, to amend this definition to read: "A practical method of handling materials, preservatives, labor, fuel, inspection and equipment in order to obtain the highest plant efficiency in accord with the treatment, equipment and materials at hand." Plant operation should not be confused with the construction or design of the plant, the condition of the materials to be treated, the quality of the preservatives or the method of treatment. All of these should be determined before the operator is asked to operate the plant. It is true, however, that proper equipment is essential to efficient operation, but I think we should assume, in the discussion of the subject, that such equipment has been provided.

Referring to the Committee's report, the first discussion under the heading "Preservatives" is a definition of creosote oil, followed by a discussion of the proper equipment and the method of determining the amount of oil injected, a method of determination of the specific gravity as well as a method of fractionation of creosote. These are followed by a technical discussion of how to prepare fused zinc chloride, the proper amount to be injected and the necessity of keeping the solution uniform, etc. These, to my mind, do not belong to plant operation, but to the chemical department and other departments of the organization necessary to properly conduct the business of wood-preservation.

There are, however, a vast number of subjects belonging to plant operation which will admit of a great deal of study in working out in detail the best method of practice in order to obtain the highest efficiency of the treating plant. These consist in a proper and efficient method of handling the material to be treated; of following out the

treatment in accordance with the specifications of handling the preservatives, fuel, the labor question, how and when the inspection shall be made in order not to interfere with the output, and the best method of handling and maintaining the equipment to obtain its greatest efficiency. This last-named subject is an extremely important one and should receive earnest consideration by the Committee. I also believe a discussion of some method of grading or determining the plant efficiency would be helpful and beneficial. The Committee seems to have taken up the subjects of what the treatment and preservatives should be rather than putting them into operation after the specifications have once been decided upon.

I realize that the operator of a treating plant is often called upon to perform chemical duties, act as a technical man, decide upon specifications and various other duties, but I do not think these should be considered as a part of plant operation. There are, however, in plant operation, two elements or duties which often seem to pull in opposite directions, one to see that the preservatives and treatment are followed out according to specifications and the other to get out a sufficient output, and I would like to devote just a few minutes to the relative importance of these two subjects before we enter into a discussion of the proper and best method of handling materials, equipment, etc.

Some operators seem to feel that it is only necessary for their plant to be so handled from day to day that a big output may be obtained and that their equipment may be in the best of shape and working smoothly in order to establish the reputation of being a successful operator, while they give little or no attention to seeing whether or not the specifications for preservatives or treatment are being properly adhered to. I realize that it is very easy to yield to the temptation that a smoothly working plant, with equipment in the best of shape, is perfectly visible and noticed at once, while the quality of preservative and treatment are more or less invisible and may not be discovered for some ten or fifteen years hence, when the timber fails, and by that time they hope to have retired. The size of the output may show greater results in dollars and cents at the present time, but a good treatment and carefully following out the specifications will certainly yield greater results in the end. I believe this tending toward output can best be overcome by having a definite specification of rather narrow limitations which will compel the operator to frequently re-treat a load when he has become careless or attempts to rush his treatment.

THE PRESIDENT: We have one written communication on this paper from our friend, Mr. Samuel T. Pollock, of the Atlantic Coast Line, Gainesville, Fla. I will ask Mr. Angier to read the communication at this time.

DISCUSSION ON PLANT OPERATION.

By Samuel T. Pollock.

There is a natural tendency on the part of operators and inspectors to do as little work which they consider unnecessary as possible, and with this in mind it might be well to italicize the necessity of reading the indicator of a float gauge only when on a level with the eye. It might also be advisable to insist upon the use of a cord between float and indicator that will be as free as possible from contraction and expansion, due to cold and heat, and will have the least possible sag between roller suspension points.

Under "Seasoning of Material" it could be pointed out that in cases where treated sills are not available ties could be stacked on green ties and after the stacked ties were loaded for treatment the sill ties could be cleaned and carried to stacks of ties which would be ready to treat in two or three weeks (usual rotation of operation across a tie yard would make this comparatively simple) and so placed in low stacks as to give the former sill ties a good chance to dry out. This same principle could be followed with timber and switch ties, especially since such material varies in length, making rearrangement of sills a constant necessity, and also because the use of short sills may make badly balanced stacks. Where very heavy stacks of material are expected, short green stanchions would prevent the sills sinking in the soil if placed crosswise beneath the sills. Lumber for structural use should have only sufficient sills and stringers to prevent sagging between supported points. With such material, when treated sills are not available, green stanchions would make fairly satisfactory sills.

From experience in treating longleaf pine piling it might be suggested that the effect of the inner skin when left on the poles in large strips, and to as great an extent as 20 per cent. of the surface, was apparently negligible so far as treatment was concerned, for no better results were secured by the same treatment when practically all of the inner skin was removed than when a great quantity of it was left on the pole.

The scheme of a fixed handling price per unit should apply to nothing but manual labor (which is doubtless what the paper means) for, if extended to supervision, it tends to result in lax checking, overchecking and general disregard for thoroughness.

Aside from steam-seasoning treatments it should be made a rule that all material with sawn surfaces should be spaced apart when loaded for treatment by metal strips, for trucks are frequently so fully loaded as to prevent the floating of their contents during treatment with a resulting poor treatment to surfaces tightly pressed together.

THE PRESIDENT: I am sorry that Mr. Pollock is not with us, and I am glad to have this communication presented at this time. I am going to ask later for our friend Mr. Fisher to discuss the subject further, but before allowing one clause of Mr. Pollock's discussion to sink too deeply I would like especially to call your attention to one point, and I am sure if Mr. Pollock were here he would agree with us, that is, "that the outer skin on the piling does not prevent penetration." I think Mr. Pollock if he were here would call particular attention to the fact that this only applied to timber that was heavily steamed, where the steaming was so heavy that the skin on the outside of the piling loosened and peeled off or was so loose that the preservatives had a chance to penetrate underneath it. I am going to ask Mr. Fulweiler for a discussion on this subject.

MR. WM. H. FULWEILER: Mr. President, I was very much interested in the paper regarding the economical handling of steam. There were two little points, however, that I think might have been touched on in the early part of this paper, where Mr. Pollock is laying down the general rule governing the consumption of steam, particularly with reference to the amount of steam consumed in compressing air. It seems to me that attention might have been called to the effect of cooling, that is to say, whether it is dynamic or isothermic pressure, as it makes a considerable difference in the amount of steam required to give a certain pressure. I think in that connection attention might also have been called to the vacuum and the temperature at which the mixture of air and water vapor came to the pump, because, as I recall it, where a given quantity of air is saturated with water vapor, at say 180° F., it would have about twice the volume that it would have at 70° F. I think it is rather important, and I thought it was so important that attention should be called to it in order to bring out this first part of the paper.

I should also like to call your attention to what seems to me a part of the report of Committee No. 1 and which rather encroaches on the subject of preservatives. It would seem from their definition the word "preservatives" might have been omitted without destroying the value of their definition for their purpose. It would seem, therefore, that the definition of creosote fell especially within the province of Committee No. 1 on Preservatives. Also the determination of specific gravity is a description of a purely technical procedure, which would be undertaken by the chemist and does seem to fall directly in the work of Committee No. 1 and not in that of Committee No. 4. The same criticism would apply to the fractionation of creosote. They have rather broadly stated some things which I think Committee No. 1 and allied committees of other societies have been working on for some time without nearly reaching the unanimous agreement which Committee No. 4

seems to have reached. I think, therefore, it would be well if Committee No. 4 would seriously consider whether they could not omit the three paragraphs which I have spoken of in their report and submit them with any further notes which they might have to Committee No. 1 for consideration.

THE PRESIDENT: I would like to ask Mr. Fisher if he has any remarks to make on this subject.

MR. WILLIAM A. FISHER: With reference to Mr. Pollock's discussion of report of Committee No. 4 I beg to say that the President is right, that in the instance at our plant where we got practically as good penetration on a charge of piling where the inner skin was not well removed as on another charge where it was well removed both charges were very heavily steamed. Whether air-seasoned piles might change with the inner skin thoroughly removed we do not undertake to say. I should like to ask the Committee on Plant Operation to answer a hypothetical question: Given a charge of cross ties well air-seasoned but dribbling wet from heavy rain, is it good practice to proceed with the treatment, provided it has already been shown by experiment that there is practically as much absorption of preservatives as if the ties were dry? I want to say it is our practice. and we have this condition very frequently. We have short, sharp, heavy rains, and it is our practice to use a preliminary vacuum with the heating coils on and then proceed with the treatment, which is by the Rueping process.

THE PRESIDENT: I would like to ask the Committee to answer that question.

MR. H. M. ROLLINS: A hypothetical question calls for more or less of a hypothetical answer. If you have a charge of ties uniformly seasoned and subjected uniformly to the same amount of rainfall subjected to the same uniform conditions in your treating cylinder you should get uniform treatment of that charge.

STRENGTH AND QUALITY OF ZINC CHLORIDE PER TIE OR PER CUBIC FOOT OF TIMBER.

By W. F. Goltra.

I was engaged on Committee work when the report of the Committee on Plant Operation was discussed, and I beg leave to submit, in writing, my opinion regarding the strength and quantity of zinc chloride that should be injected per tie or per cubic foot of timber.

There is apparently a wide divergence of opinion and misunderstanding among users of chloride of zinc, and I believe that this is due

to the fact that some important features are left out in the consideration of this question. These are:

(1) The individual variation in absorption of the solution by various kinds of ties and different species of wood.

(2) The temperature of the solution at which the percentage of strength is taken.

It has been almost the universal custom in this country to specify a certain quantity of dry salt per tie or per cubic foot of timber on the supposition that individual ties, in the same charge, absorbed an equal quantity of solution. This is incorrect. It has been clearly demonstrated that the absorption of individual ties, in the same charge, varies greatly, depending upon many factors, such as species and character of wood, degree of dryness, size of tie, etc.

Supposing we are treating oak, beech and loblolly or soft pine ties with a solution 3 per cent. strong—that is to say, 3 pounds of dry salt dissolved in 97 pounds of water—the individual ties will absorb the following quantities of dry salt:

ABSORPTION OF CHLORIDE OF ZINC.

	Solution—Pounds.		Dry Salt—Pounds.	
Species.	Range.	Average.	Range.	Average.
Oak	10 to 50	30	.30 to 1.50	.90
Beech	20 to 65	42	.60 to 1.95	1.27
Pine	30 to 90	60	.90 to 2.70	1.80

Thus it will be observed that some ties will absorb as little as .30 of a pound of salt, while others will absorb as much as 2.70 pounds per tie. Perhaps the average would figure 1½ pounds per tie, but that is manifestly not the proper way of specifying the quantity and strength of chloride of zinc that should be injected into the timber.

Secondly. The temperature of the solution must be taken into consideration when the readings are taken with Beaume's hydrometer, In the heavier solutions, say 30 to 60 per cent. strong, the influence of temperature is small, so that no account need be made of it, but with that highly diluted it is necessary to define the effect of temperature very carefully to get true measurement of strength.

The degree of dilution recommended by Sir William Burnett is one part of volume to fifty parts of water, that is to say the strength should be two per cent. The late Samuel Rowe, who perhaps had as much experience as any man in this country in the use of chloride of zinc, professed to have demonstrated that one-quarter to one-third of a pound of chloride of zinc salt per cubic foot of timber, in the shape of 6x8″x8′ pine ties, was sufficient to protect them from decay. European railways do not specify the quantity of salt per tie or per cubic foot of timber treated. They specify the degree of strength, according to Beaume's hydrometer. For example, the specifications of the Imperial Railways of Alsace-Lorraine, Germany, and the Bavarian Railways read thus:

"The solution must have a strength of 3.5° Beaume—1.0244 specific gravity at a temperature of 15° C. (59° F.)"

The Prussian Railways specifications read thus:

"The solution must have a strength of 3.0° Beaume at 14° Reaumer (63° F.)"

The percentage of strength of solution used by European Railways is therefore between 2 1-2 to 3 per cent. The solution is injected to refusal and no variation is made in the strength of the solution for different species of wood, the same strength being employed for all woods, whether they be oak, beech or pine. That seems to be rational, as no one has as yet demonstrated, or even asserted, that the solution should be made stronger for one species of wood than for another.

EQUIVALENT STRENGTH OF SOLUTION FOR DIFFERENT DEGREES BEAUME AT VARIOUS TEMPERATURES.

Divisions on Beaume Hydrometer.	Temperature deg. Fahr.	Equivalent strength per cent.
2 deg.	70	1.75
2.5 "	90	2.50
3 "	60	2.42
3 "	70	2.59
3 "	80	2.75
3 "	90	2.92
3 "	110	3.33
3.5 "	60	2.83
3.5 "	70	3.00
3.5 "	80	3.18
3.5 "	90	3.37
3.5 "	110	3.83

The strength of the solution should be sufficient to prevent decay, and possibly a little more to make up for any loss that might leach out of the ties in the course of time. It should also be borne in mind that this can be overdone and there is danger of making the solution too strong and injure the fibre of the wood.

Many of the specifications in this country, covering the treatment of ties with chloride of zinc, call for an injection of a mean between these two extremes, namely, an average of one and one-half pounds of dry salt per tie. Some specifications require the injection of a specific quantity of salt per tie, regardless of the quantity of solution absorbed by individual ties, and furthermore, when the average absorption of the solution of a certain percentage of strength is not enough to conform to the requirements, as stated by the Committee, the strength is "manipulated" so that the required amount of dry chloride of zinc per tie is injected.

It has never been found possible, by any known process, to inject into each and every tie an equal quantity of preservative, therefore the strength of the solution should be fixed and not the quantity of dry salt per tie or per cubic foot of timber. Some ties may absorb but little, while others a great deal, but the strength of the solution should be the same for all. The strength should be expressed in degrees Beaume, at a certain temperature. Then, and not until then, will we

have a definite understanding as to the strength and quantity of chloride that should be used for treating ties and timbers.

In conclusion I beg to submit the following specifications for the treatment of railroad ties, of all kinds, with chloride of zinc, either singly or in combination with creosote oil:

> "The zinc solution must have a strength of 3.5° Beaume at a temperature of 70° F. This is equivalent to 3 per cent. strong. Ties of all kinds and sizes should be treated to refusal."

These specifications would be comprehensive, definite and complete and admit no misunderstanding. Why not adopt them?

THE PRESIDENT: Gentlemen, is there any further discussion on this subject?

Mr. M. K. Trumbull then presented the following written discussion:

DISCUSSION ON THE ECONOMICAL USE OF STEAM.

By M. K. Trumbull.

Mr. Lockett's paper on the "Economical Use of Steam in Connection with Wood-Preserving Plants" is a valuable one. We are indebted to him for preparing and submitting it. His paper covers the subject in a broad way.

Few writers are able to generalize in treating their subjects so as to cover the essential points. This Mr. Lockett has done most acceptably. The last three or four paragraphs of his paper, however, suggest matter which he has withheld from us. These closing paragraphs serve to whet our appetites for more data of a similar nature.

We know the author is competent to lead us into deeper water. I, for one, am in favor of naming this paper "Lockett No. 1 on Treating Plant Fuel Economy" and inviting him to build up a series of papers on this foundation for future submission.

We can all avail ourselves of elementary treatises on steam economy. I say this with full appreciation of the merits of Mr. Lockett's paper. We are all beneficiaries of his application to the elements of fuel economy to wood-preserving plants.

Our problem must be to draw Mr. Lockett out of his shell and induce him to further develop this broad and important subject. If he does not accept the honor, no doubt some other expert will. Possibly, however, it may be desirable to have this matter handled by a committee of the Association, of which Mr. Lockett should be a member. He should be afforded the first opportunity, however, not only because his paper opens the subject but for the reason that his experience points to his assignment.

The foregoing suggestion is one for the Executive Committee to consider. I am merely giving expression to my individual ideas.

A few of Mr. Lockett's statements are so admirably framed and impress me so profoundly that I cannot refrain from focusing your attention upon them for a moment. These are:

> "From the standpoint of an engineer interested in the general proposition of steam plant economy it has seemed to me that the managers of most of the wood-preserving plants visited by me are so intent upon maintaining the maximum output that the question of steam economy has not received the attention to which it is entitled."
>
> "A pound of coal or any other fuel is valuable to you directly in proportion to the heat it will give off when burned. One pound of coal is said to contain so many heat units when burned, and it is your duty to yourself to, as nearly as practicable, see that every unit of heat which is given off by the coal burned in the furnace of your boiler does useful work."
>
> "It is, of course, not possible to prevent certain losses, but it is not only possible but quite practicable to prevent the majority of losses which take place in plants making use of steam."
>
> "It goes without saying that all steam leaks should be promptly stopped, but having seen plants where a number of steam leaks exist without apparently giving the plant managers any concern, I think it is not out of place to mention this because some of you might not realize the great expense a number of such leaks will entail, although each one of them might be trifling in itself."
>
> "There seems to be a common impression among the employees of these plants that so long as the boilers are there and capable of furnishing steam no special care need be exercised in the use of this steam."
>
> "The steam in your boilers is just as much money as the actual coin in your safe and it should not be used with any less care."
>
> "Manifestly, therefore, the first step towards economy in the use of steam is to reduce to the minimum the amount of work done by the steam-consuming machinery, and the second consideration is to increase to the maximum the efficiency of the machine performing the work."
>
> "The only kind of work which adds to the value of the thing produced is the useful work, and any unnecessary work is a pure and simple expense which is without value to anyone."
>
> "The lifting of loads by hoisting apparatus costs in proportion to the weight lifted and the distance through which it is lifted. Therefore, if we must handle these weights we should be careful not to hoist them to unnecessary heights."

To the last paragraph I would add a clause, making it read as follows:

> "The lifting of loads by hoisting apparatus costs in proportion to the weight lifted and the distance through which it is lifted. Therefore, if we must handle these weights we should be careful not to hoist them to unnecessary heights," *or to lift a larger load than necessary.*

In expanding briefly upon the last three paragraphs quoted from Mr. Lockett's paper, it will be found that in studying the economy of steam in a treating plant attention should first be given to those factors in the installation which develop the greatest consumption of steam. This statement is made upon the assumption that the boiler plant itself has been brought to the highest state of efficiency.

Heating of the oil in the storage and working tanks comprises one of the heaviest duties upon the steam plant. This is, therefore, a prime factor.

Our aim, therefore, should be that the load created in heating oil, preparatory to admitting same to the retorts, should be the minimum. We find that the customary method of heating this oil is by the use of coils or heating pipes in the oil storage and working tanks. This requires heating the entire volume of the contents to the temperature at which oil is required for use in treatment. Many operators, probably, have overlooked the self-evident losses that are bound to occur in this method and that the efficiency of the work is low.

This low efficiency is due to the following conditions:

First: The radiating surface of a storage or working tank is large. The tank is customarily located in an open atmosphere, where there is a continuous change of air in contact with the shell of the tank. Heat is, therefore, rapidly carried away.

Second: The principle of heating a liquid by the use of steam is to pass this liquid over the surface which separates said liquid from the vapor. It is self-evident that the more the liquid is agitated over such heating surface the more economical will be the transmission of heat to the liquid. Reviewing the actual conditions usually encountered in the heating of working and storage tanks, we find that the volume of liquid is large as compared with the actual heating surface of the coils. This results in a condition by virtue of which the individual molecules come in contact with the heating surface very slowly. The operation usually depends upon the natural circulation, due to a portion of the oil being hot while the rest of it is cold. A long time is, therefore, required to produce the necessary temperature in the entire volume of oil. This condition would not be of vital importance if no radiation losses occurred. It is a well-known fact that while this slow process of heating takes place there is a rapid loss due to radiation, which loss is proportionate to the time required to raise the temperature of the oil and increases as the temperature of the oil increases. Reduced to a few words, we find that the greater the difference between the temperature of the oil and the atmosphere the greater is the number of the B. T. U. carried off in the atmosphere.

Third: Invariably the quantity of oil in the tank is greater than the quantity of oil required in the retort. It results, therefore, that a considerable proportion of the energy used in heating this surplus oil is lost. Moreover, by virtue of this surplus, the condition conducive to making the losses covered in the first and second conditions just named are increased. To sum up, therefore, the load, or duty, of the boilers is greater than is required.

In considering a remedy for these large losses it might first be suggested that we cover the tank with an insulating material. It is found that on account of its size this expedient is expensive. There is no question but what this remedy would be found to save money

for the operator, but it may be considered a makeshift. It is only partly productive of results and at its best does not eliminate some of the aforesaid losses.

Let us now consider the real principle of the process. In reviewing what is being done in these modern days in the heating of water and other liquids in different processes of manufacture we may find that present practice of treating plants is an antiquated method of transmitting heat and one that has in many modern plants in other lines been cast aside as being too uneconomical to be considered. If this is uneconomical for their use, it may be for a treating plant.

The modern method for heating large quantities of water or other liquids used in manufacture is by the use of closed heaters, the primary principle of which is to break up the liquid into small volumes and passing it through a series of tubes surrounded by steam. This causes all molecules of the liquid to come into rapid and continuous contact with the heating surface. The liquid is heated during the process of delivering it to the machine or whatever purpose for which the hot liquid is used. These tubes are nested close together. The outside radiating surface is reduced to a minimum. This permits the outside of the heating device to be insulated at a small cost. The heater is located inside the building. This also assists in reducing the radiation loss.

Such a type of heater has the advantage of heating only the quantity of oil required in the retort. The heating process takes place, as stated, while the oil is passing from the tank to the retort. This may be made to occur at the desired rate, employing the same pump that is now being used or a gravity flow.

By the use of two of these heaters exhaust steam may be used in one. The oil is thus preheated before passing to the second or live steam heater, where the final temperature is attained. It is likewise possible to arrange, by the use of thermostatically controlled valves, to heat the oil to the required temperature. These automatic valves are controlled by the temperature of the outgoing oil, so that the minimum amount of live steam is admitted.

These heaters are also more efficient as transmitters of heat. They not only break up the liquid into small volumes but require less steam by having the tubes of thin steel or brass.

This type of heater has shown, in other lines of business, a large economy as compared with the older method of heating large quantities of liquid in tanks. Inasmuch as the efficiency has been so great in other lines of manufacturing it would appear to merit our serious consideration in its application to treating plants. The principle upon which this method is based is not a patented one. In fact, the theory is quite simple.

The interest of the writer was drawn to this method by an installation for heating water in laundries. He has since learned that it is being used quite extensively in heating crude oil for loading in and out of tanks and vessels. The writer understands that the time required to unload a 50,000-barrel tank of Mexican crude oil by this method is less than half of what was necessary under the old method. A number of these installations have been made on tank steamers, as well as storage tanks, apparently with unqualified success physically, as well as affording marked economy of cost.

MR. J. H. WATERMAN: Mr. President, I think on plant operation there are two points that ought to be emphasized and I do not know that they have touched on them. I would say one is how well you can do the work. That does not mean overdoing it, but to see that the work is well and thoroughly done. The other point. you are not getting any efficiency out of your plant unless you have material in the retort and the door is closed and you are operating. I have been over this country quite a little and ofttimes I find retort doors wide open and nobody seems excited. If our retort doors are open there is a man that is very much excited around Galesburg. We want first something doing in the retort or coming out or something in the retort being treated, and you would be surprised if you keep a record of the time your retorts are idle the percentage of loss you have.

Another point I want to make on treating is with reference to the storage of treated material at the plant. I do not believe anybody stores very much treated material at a plant, do they? We do not. You want to be careful, because the insurance man will go after you pretty hard if you store very much. I see my friend Mr. Rex, from the way he expresses himself without saying anything, evidently stores a large amount of treated material.

I want to say one word on this steam proposition. I was asked to write a discussion on this, and I presume you people will all feel that for once my judgment was good when I refused to do it, but I have a criticism to make. In places in his paper Mr. Lockett talks about creosoting plants as though there was not any other plant in the United States that treated timber. There are plenty of plants, or there are some that treat timber, or rather ties, with zinc. I would suggest before this is printed that he strike out that word and say "treating plants." In other ways I want to compliment Mr. Lockett very highly on all of the paper.

MR. C. M. TAYLOR: Mr. President, I would like to see Mr. Crawford's remarks carried a little further, and in that connection

it is rather remarkable that we have as President this year a man who as a plant operator is second to none and who in his plant operations handles the points brought up by Mr. Crawford in a very nice way. He has his operating department and his chemical department. The operating department covers the plant operation. The chemical department is the department which checks the plant operation. In other words, I doubt if there is any plant in the United States that has a closer inspection of treated material than those plants operated by our President. I think we should all take due notice of his methods of operating and of his methods of surmounting the difficulties brought out by Mr. Crawford.

THE PRESIDENT: Gentlemen, we have made most excellent progress in our program this morning, and in order not to delay or to lose the advantage that we have gained and in order also to give everybody full opportunity to discuss a paper that they did not expect until this afternoon we are now going to take a recess, and I hope that each of you will make a special effort to get back in your seats so we can start the session promptly at 2 o'clock. I hope we will have a full discussion of this subject.

An adjournment was then taken until 2 o'clock P. M.

TUESDAY AFTERNOON SESSION.
January 19.

The convention came to order at 2 o'clock P. M.

THE PRESIDENT: We will now continue the discussion on the report of Committee No. 4 and Mr. Lockett's paper.

MR. W. W. LAWSON: I want to ask this Committee to modify the recommendation regarding the minimum amount of dry chloride of zinc that is to be injected per cubic foot which reads: "Since established records, supplemented with laboratory tests, indicate that one-half pound of dry chloride of zinc per cubic foot of timber is essential to insure proper protection against decay, the use of smaller quantities is not considered standard practice." There is one railroad company that for more than twenty years has had its ties treated with one-quarter pound of dry chloride of zinc per cubic foot of timber, and I think the results generally have been satisfactory.

MR. F. D. MATTOS: Mr. President, I would like to state in regard to that the Southern Pacific Company only specifies one-quarter pound per cubic foot of fused zinc chloride, and we are getting good results. We do not, however, adhere to one-quarter pound, our absorption ranging from one-quarter to three-tenths pound per cubic foot. We aim to weaken the strength of our solution so that we can

treat to refusal and keep the absorption as near one-quarter pound per cubic foot as possible. Douglas fir ties are what we are receiving for treatment.

MR. F. J. ANGIER: I would like to ask Mr. Mattos if he has any records to show what life is obtained from a quarter-pound zinc chloride treatment.

MR. F. D. MATTOS: Of course, we do not season our ties. In some cases they are put in track immediately after treatment, and we get an average life of about ten years. We have had cases where they lasted even longer than that, and on the Portland Division ties are being taken out that have been in from 12 to 15 years.

MR. F. J. ANGIER: Have you any records available that you could give us?

MR. F. D. MATTOS: Not with me.

THE PRESIDENT: Mr. Taylor, will you give us your idea? You have handled zinc a long time.

MR. C. M. TAYLOR: I hardly have anything I can offer which would be of any value to a person considering the use of zinc chloride because I have no definite results. The Southern Pacific have always been held up as people who have had wonderful results with ¼ pound zinc chloride to the cubic foot, and I doubt whether anyone else in the United States has had anything like the results with ¼ pound per cubic foot treatment that they have had, and I do not think we altogether feel that they have taken everything into consideration in working up a ten-year life from ¼ pound treated ties. The zinc ties we have had the best use out of were treated by Mr. Chanute, but the records of those ties are not available. There is no question but that you can get your money back in treating ties with zinc chloride in most locations, but our service tests are not of a character that we can come out in the Association and say that you are going to get definite results in every location where it is used, but there ought not to be any hesitancy in using zinc chloride in a great many localities in the United States.

MR. W. W. LAWSON: I do not wish to be understood as recommending the adoption of ¼ pound of dry chloride of zinc per cubic foot of timber as standard practice for all. However, I do not want the use of this amount condemned, for in many places it has proven to be sufficient to prevent decay until the ties were worn out mechanically.

MR. F. D. MATTOS: Mr. President, I think the life of ties treated with zinc chloride depends entirely upon the class of material you get to treat. I believe if you treat loblolly pine or any of those spongy, sappy woods the zinc chloride is more apt to leach out.

We have some zinc chloride treated ties that were placed in our experimental track that have been in nine years and they are still there.

MR. WM. J. TOWNSLEY: Mr. Chairman, may I have a moment?

Somebody has tried to lay down an arbitrary rule that a given quantity of chloride of zinc is enough. It may be too much even though it be the minimum quantity. That is to say, it may be used in timber that is going to be used under conditions where practically no preservative is necessary. On the other hand, that timber may be used under conditions quite adverse, where two or three or even four times as much chloride of zinc would be none too much. In one case (Mr. Taylor just referred to it) the Union Pacific had good results with ¼ pound treatment. Did I misunderstand you?

MR. C. M. TAYLOR: Southern Pacific.

MR. J. H. WATERMAN: The Union Pacific uses ¼ pound too.

MR. WM. J. TOWNSLEY: They did use ¼ pound for a time after the consolidation of the two systems, and then came back to four-tenths, while I believe the Southern Pacific still adheres to ¼ pound. I know of one plant at one time operating on a 6 per cent. solution, injecting all the timber would take, and I have seen the operation report showing that a number of charges had taken 1.8 pounds of dry chloride of zinc per cubic foot. Their instructions were to put in all it would take. That was without any question a waste of chloride of zinc. If each plant operator could know for a certainty where and under what conditions the ties he treats are going to be used he could regulate his treatment according to conditions, but as he cannot in the majority of cases know these things he is obliged to (at least he ought to) put in enough preservative, no matter whether chloride of zinc or a mixture, to protect the timber efficiently against the most adverse conditions that may be encountered. It seems to me, speaking purely as a chloride of zinc man, that it is impossible to say arbitrarily that ¼ pound is the proper amount or that four-tenths, five-tenths or six-tenths is the proper amount to be used under all conditions, but that the quantity must be determined by the character of the wood and the service that is expected from the timber treated.

THE PRESIDENT: Is Mr. Maitland of the Union Pacific in the house?

MR. G. F. MAITLAND: Yes, sir.

THE PRESIDENT: I would like to hear from you, Mr. Maitland.

MR. G. F. MAITLAND: We are using 0.4 pound of zinc chloride per cubic foot of timber. While the Union Pacific and Southern Pacific were under the same management we used ¼ pound in accordance with Southern Pacific practice. However, after the two systems were

separated, we went back to our former practice of using 0.4 pound of zinc chloride per cubic foot.

THE PRESIDENT: I would like one report in here. I do not know whether Mr. Lawson will take exceptions to it, but Mr. Mattos, who is Superintendent of the West Oakland plant of the Southern Pacific System, is treating Douglas fir ties cut out of large trees, and I believe it is safe to say that 85 per cent. are heartwood.

MR. F. D. MATTOS: Yes, I guess it is more than that. There is little or no sapwood, and what we aim to do is to work as low a strength solution of zinc chloride as we can, that is to say, from a 2.2 per cent. to about 2.6 per cent. and treat to refusal, and in this way get the solution diffused throughout the tie. We find in working a solution of this strength that in treating Douglas fir ties our absorption is from ¼ to 0.3 pound of fused zinc chloride per cubic foot. Our average absorption for the year 1914 was 0.28 pound per cubic foot at West Oakland and 0.26 pound per cubic foot at our Los Angeles plant.

THE PRESIDENT: What per cent. solution do you use, Mr. Mattos?

MR. F. D. MATTOS: Anywhere from 2.2 to about 2.6, depending upon the class of timber from a point of resistance.

THE PRESIDENT: Now that has everything to do with what you are going to use. We all know that the heartwood of the timber does not take the penetration like the sapwood. Anybody who uses 75 per cent. or 85 per cent. heartwood could very easily and rightfully use a much less amount of zinc per cubic foot and be in safety than those of us that are using more porous wood and a larger per cent. of sapwood. I, personally, would prefer a little stronger solution for that class of timber. A portion of our timber is similar to Mr. Mattos', that is, it is longleaf pine, and I would say that it was 85 per cent. heartwood. We use on that timber only 3 1-2 to 4 per cent. solution and treat the timber to refusal, as is the case in Mr. Mattos' practice. While safety to use a little stronger solution in the all-heart timber. I hope Mr. Lawson, if he has any objection to that, will make it plain, because I do not want in any way to influence anything here.

MR. J. H. WATERMAN: What do you average per cubic foot?

THE PRESIDENT: We average 0.4 in longleaf timber; in this sawn-heart timber we average 0.4 to 0.5. In the loblolly and shortleaf and the timbers of that nature we run as high as 0.65 pound of dry zinc to the cubic foot.

MR. W. W. LAWSON: I would like to ask Mr. Rex if he would use the same strength of solution for treating both longleaf and loblolly pine ties?

THE PRESIDENT: No, sir. We feel as though any timber should be treated to refusal regardless of the fact whether it is sap,

heart, hardwood or softwood, and we regulate our strength of solution so that we get it somewhere near an average of 0.5 pound. As I say, in the one case it is 0.4 and in the other case 0.65, but we use a solution that will give us as near 0.5 pound as we can well work it.

MR. W. W. LAWSON: Do you have in mind about what per cent. solution you use on the soft loblolly pine ties?

THE PRESIDENT: From 1¾ to 2.

MR. W. W. LAWSON: It seems to me that the present method of measuring the treatment of ties by a specified amount of dry chloride of zinc per cubic foot is wrong. I think that the strength of the solution should govern the treatment. Take, for instance, our Southern pines. The longleaf pine is naturally more resistant to decay than loblolly pine, yet the universal practice has been to use a stronger solution, higher in toxic value, on the wood that is resistant to decay than that used on the wood which decays very quickly if not preserved. Longleaf pine ties, averaging 15 per cent. of sapwood, treated with 1½ pounds of chloride of zinc per tie, will have practically all of the chloride of zinc in the 15 per cent. of sapwood, while loblolly pine ties, 100 per cent. sapwood, treated with the same amount of chloride of zinc per tie, will have that zinc distributed throughout the tie, thus giving the longleaf tie more zinc per unit of wood actually treated than is given the same unit in the loblolly. This is certainly not logical, and because it has been followed zinc-treated loblolly pine ties have not given the life expected.

THE PRESIDENT: May I call on Mr. Ford of the Rock Island?

MR. C. F. FORD: I do not believe I have anything to say, Mr. President.

THE PRESIDENT: You can tell what your practice is, can you not, Mr. Ford?

MR. C. F. FORD: It is our practice to use 0.5 pound of zinc chloride per cubic foot of timber. This applies to cross ties, switch ties or bridge timbers. In the treatment of cross ties, switch ties or bridge timbers we use a 4 per cent. solution. In the treatment of pine ties we use a 2 per cent. solution.

THE PRESIDENT: Mr. Steinmayer, we would like to hear from you.

MR. O. C. STEINMAYER: Mr. President, as to the remarks made by the previous speaker in regard to the strength of the solution and the apparent inconsistency in the suggestion to use a stronger solution for heartwood timber and a weaker solution where the wood is mostly sap, I think he has failed to take into consideration that one of the objections to zinc chloride is it leaches very badly. Consequently in the heartwood ties, in which most of the penetration is on the outside where this leaching first occurs, you will have to protect that wood with a greater amount of zinc chloride, necessitating a stronger solu-

tion, in order to make it as resistant to decay as the center or untreated portion.

MR. AUGUST MEYER: If I understand Mr. Lawson's question rightly, I may answer this by saying that the strength of a zinc chloride solution must be governed entirely by the absorptive power of the wood which it is desired to treat; for instance, if Mr. Lawson wants to treat shortleaf pine, cypress or other very easy treating wood, which absorbs from 35 to 40 per cent. by volume of solution and 0.5 pound dry zinc chloride per cubic foot is required, he will, of course, use a solution which will give him 0.5 pound of dry zinc chloride per cubic foot after the wood has been treated to refusal. On the other hand, if Mr. Lawson wants to treat beech, red oak, tamarack or other similar refractive wood, which absorbs only from 18 to 24 per cent. by volume of solution, he will, of course, be obliged to use a much stronger solution than he would use for the easier treating woods in order to get the proper amount of dry zinc chloride per cubic foot.

THE PRESIDENT: Mr. Bacon, have you some remarks to offer here?

MR. W. L. BACON: Our practice on the Northwestern during my experience, covering a period of ten years, has been to inject an average of 0.4 pound of zinc chloride per cubic foot. This we did for five years (1903 to 1908), the process used being the Wellhouse, changing in 1908 to the Card process (zinc-creosote mixture). We followed the practice of injecting the same amount of zinc chloride as with the former or Wellhouse process. At the present time, using the Burnett process (straight zinc chloride treatment), the amount injected per cubic foot is increased to an average of 0.5 pound.

In this connection I am much interested in the matter of the leaching out of the zinc chloride, about which we hear so much. Admitting that it is a fact that under some soil and climatic conditions the zinc may leach out to some extent, I doubt that this feature is as bad as is often claimed. Speaking briefly, I will say that I have recently, in company with an official of the road, made an inspection of a stretch of track 22 miles long, laid with 76,000 Wellhouse-treated ties. These ties (hemlock and tamarack) were treated in 1904 with an average injection of 0.443 pound of zinc chloride per cubic foot. The ties were laid in the roadbed referred to late in 1904 and early in 1905; I would consider them all laid in 1904. The inspection was made at four different points, taking 300 ties at each point for average conditions. The report officially made was that no ties had been removed for any cause after nine full years of service and 98 per cent. will be in for ten full years. The ties were plated on the curve, but not on the straight line. Being interested at the time in knowing how much zinc still remained in the ties, I suggested that borings be taken from ten ties, which

was done. The findings reported by the chemist and engineer of tests was 0.230 pound per cubic foot. I think 0.4 to 0.5 pound zinc injected is sufficient.

MR. J. B. CARD: Mr. President, I wish to ask Mr. Bacon if these ties did not have glue and tannin treatment in addition to the chloride of zinc?

MR. W. L. BACON: I am glad you mention that fact as I feel that the glue and tannin treatment should receive full credit.

THE PRESIDENT: They were Wellhouse-treated ties?

MR. W. L. BACON: They were Wellhouse ties, and I would say that I consider them practically the same thing.

THE PRESIDENT: We are certainly pleased to hear this testimony to the life of zinc ties. We can seldom get accurate records of this nature, and it adds to the value of our work very much indeed to have such excellent testimony. As regards the leaching, we seldom get hold of real information on this subject; it is mostly hearsay, but I am going to ask Mr. Angier if he will not give us a few suggestions on the results of a leaching test which he attempted to carry on at Sheridan some years ago which to me has always been interesting.

MR. F. J. ANGIER: The test Mr. Rex refers to was made about 1902 or 1903, and I cannot now recall the exact details. The manner in which the test was made was to immerse the ties in water for twenty-four hours, then to take them out and dry them for six days, and to repeat this operation each week. The ties were first treated with a known quantity of zinc chloride. Pans were made just large enough to hold one tie and a tie placed in each pan and weighted down. After each immersion the water was analyzed to determine as nearly as possible the amount of zinc that had leached from the ties. The first few immersions showed a comparatively large amount of zinc, but this gradually became less until at the expiration of 300 days there was only a trace of zinc, and if my memory serves me correctly we got a total of 28 per cent. of the zinc chloride that had been originally injected when the test was finished.

THE PRESIDENT: This to my mind has been one of the most interesting tests that has been carried on, and while it is on a small number of ties it is well worth having this information in our Proceedings, and I am going to ask Mr. Angier to supply these figures. As I remember it, the figures of washing and leaching out was a little larger than his memory of the matter, but he will supply those figures, but even though such a severe condition as that of 300 days of soaking—a condition that has never been reached with a zinc-treated tie in service—even though there were 75 per cent. of it leached out, it is to my mind excellent proof that the leaching of zinc chloride has been a ghost that we ought not to be afraid of. I just happened to have occasion about

a year ago to stop at a little station we have down in Eastern Texas where the rainfall is about 52 inches a year and practically every morning in the year the dew is so heavy you would think it was rain. I had a few hours there waiting for the train, and I went out and examined the ties a mile each side of the station, counting the ties I found in that track with no tie plates, with nothing but Texas pine (possibly the better grade of pine, because it was the earlier years in that section that the ties were cut) and I found that the 500 ties put in under the severe conditions previous to 1900 had given us 13 years of life in that severe leaching condition, a condition which we usually say is not fit for zinc chloride.

MR. WM. J. TOWNSLEY: Mr. President, if I may just add a word to what Mr. Angier has said, I think when he consults his records he will find he has quoted his percentage correctly. Recently I had occasion to look at his original report, and my memory is that it was 28 per cent., or within a very small fraction of 28 per cent.

(The following remarks have been taken from a paper by Mr. Angier, read before the New York Railroad Club in February, 1910):

LEACHING OF ZINC SALTS AND EFFECTS OF IMPROPER DRAINAGE.

By F. J. Angier.

A series of leaching tests were made to test the rate with which zinc chloride leaches from timber treated with the Burnettizing process. Lodgepole pine and Douglas fir ties were used. Some of the ties were seasoned six months after treatment and before the test for leaching was begun, and others were freshly treated and were full of the water solution.

To carry out this test a number of pans were constructed large enough so when filled with water an entire tie could be submerged. The object of the test was to determine whether zinc chloride would leach out from ties as rapidly as we were inclined to think would be the case and also the relative leaching of seasoned over freshly treated ties.

The ties were first carefully treated, weighing before and after treatment, to find as nearly as possible the number of grains of pure zinc chloride absorbed by each tie.

To determine the amount of zinc chloride leached out, each tie was placed in the pan filled with water and left 24 hours, after which it was taken out and allowed to dry six days. This process was repeated continuously for many months. After each soaking a measured quantity of the water was taken out from the pan and the amount of zinc chloride determined.

The accompanying diagram will show in a graphic way the results of this experiment:

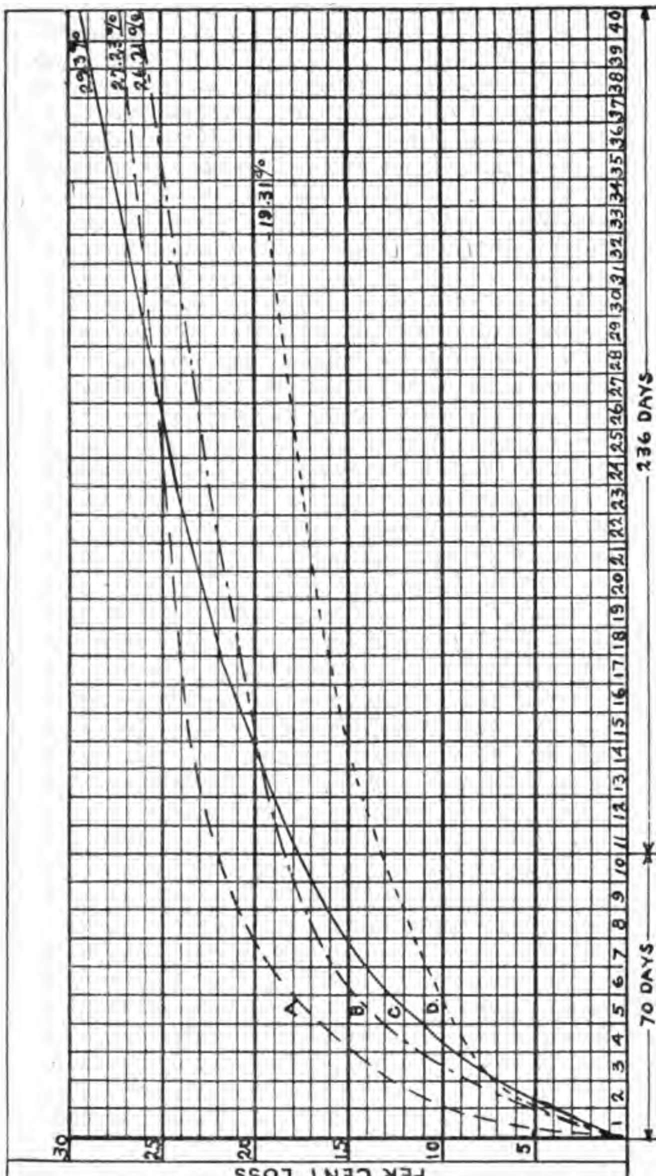

Diagram Showing Results of Experiments in Determining Leaching of Zinc Chloride.

Line "A" represents freshly treated Douglas Fir Ties.
Line "B" represents seasoned Bozeman Fir Ties.
Line "C" represents seaoned Lodgepole Pine Ties.
Line "D" represents seasoned Douglas Fir Ties.

A study of these results shows that in carrying out a leaching test in this way less than 30 per cent. of the zinc chloride can be gotten out of the wood in nearly a year's time and that the largest part is leached out in the first 70 days, or approximately 18 per cent. It also shows that with the freshly treated ties the leaching was much more rapid, almost the entire loss being within 70 days.

MR. F. D. MATTOS: Mr. President, during the year 1906, under the directions of our consulting engineer, Mr. John D. Isaacs, we treated something like 280 7"x9"x8' sawed Shasta sap pine ties and 93 7"x8"x8' Douglas fir ties for experimental purposes. They were treated by our regular zinc-chloride process and followed up with an injection of crude oil. I went over 280 of them that were put in the Oakland main-line tracks a few months ago, and every one of them was still in service. The life of Shasta sap pine ties untreated is anywhere from a year and a half to two years, and I have seen them rot in the pile in six months. In one of the experiments we treated 140, injecting the crude oil first and the zinc chloride afterward. In the second experiment we treated 140, injecting the zinc chloride first and the crude oil afterward, and thus far there is no noticeable difference in life of them. Today every one is in the track and in good shape. They have been in pretty nearly nine years.

MR. A. C. BECKER: On the Grank Trunk we have no dating nails from which I could give any figures, but in walking over the tracks of another road, just north of the Ohio River, I found some ties that were put down in 1903 and 1904. They had the dating nails in them, and I found a section foreman who was on that section at the time the ties were put in the track. The carload of ties that was put in 1903 was red oak treated with straight chloride of zinc.

This car contained 400 ties, and of this number he had removed 67 for rail wear and 2 for rot. The 2 rotten ties he said were rotten when they were treated. I got some chips and had them analyzed. Red oak samples showed 0.15 per cent. of zinc. This sample was taken from the corner of the tie where there would be the most leaching. Figured down to the weight of red oak, this shows 13 per cent. of the original amount of zinc chloride injected, supposing that there was 0.5 pound per cubic foot. The elm ties were in the track nine years. They showed 8.8 per cent. of the original injection. Tests were not made on borings. These samples were chips taken from the corner of the ties.

MR. J. H. WATERMAN: How long had the ties been in the track?

MR. A. C. BECKER: The red oak ties were in the track ten years and the elm ties nine years. Out of the 400 red oak ties only 67 have been removed, and they had all been removed because of rail wear, except two ties, which were rotten when they were treated.

THE PRESIDENT: We will deviate a little from our committee reports. This report has been a very interesting one and the discussion has been very full, but we will now have to take up and dispose of the report of Committee No. 4.

MR. A. E. LARKIN: Mr. President, if I am not out of order I would like to get some more information from Mr. Rollins before the report is dispensed with. I know he must have some very valuable information that he has collected during this last year. His report contains the following:

"Preparation of Solution. The fused chloride shall be put into a small vat, or tank, preferably of steel construction."

I would like to know what Mr. Rollins recommends? Does he mean by "steel construction" to include a pure iron tank or a common steel tank, and what about the wooden tank, especially for the concentrated solution?

MR. H. M. ROLLINS: Mr. President, having had a number of years experience with a wooden vat lined with lead for a mixing vat for zinc chloride solution, would say that such a vat was not satisfactory and was a source of continual trouble. I went on a trip to the Pacific Coast some years ago, and there I saw a steel tank used for a mixing vat. It looked unusual to me, and I asked the operator if he did not have trouble with the action of the chloride upon the steel, and he said:

"No. We merely give the inside a coat of coal tar and it lasts indefinitely."

When I got back to Houston, I had a steel vat built for mixing the chloride solution and had no further trouble and am satisfied that the steel vat is still doing service at Houston.

MR. J. A. JOHNSON: At Laramie we have a steel tank for mixing the concentrated solution in. It is made of ⅛-inch material and has been in use about ten years and is undoubtedly good for another ten years. When we first started to treat ties we used a lead-lined wooden vat, and although we chopped up the chloride, now and then pieces would be dropped in that were large enough to make a dent or a hole, and pure lead is very difficult to solder. It means considerable loss of the concentrated solution. Whenever we have the opportunity we apply a heavy coating of tar paint, and where two or three coats are put on it lasts for a long time, and we have no trouble whatever with leaching out through seams.

MR. J. B. CARD: Mr. President, it is only hot chloride of zinc that will affect steel tanks. Cold solutions will not affect it at all. We have been using one tank for over 20 years now and it is still in use. We simply keep a little spelter in the bottom and if there is any action at all it acts on the spelter and not on the tank.

THE PRESIDENT: Have you anything to add to this, Mr. Waterman?

MR. J. H. WATERMAN: We get our zinc in 50 per cent. solution in tanks at Galesburg. I do not know whether our tanks are steel or iron, but we have had no trouble with our tanks. We put the tank in in the year 1908 and it is all right yet.

THE PRESIDENT: I just want to ask one favor of the members of the Association. In getting upon the floor to speak kindly call your name so anyone in the house who does not happen to know you will know who is speaking. If you will mention your name you will help the other members in getting you placed. We will now dispose of the Committee report.

MR. A. E. LARKIN: Mr. President, this last point that Mr. Rollins brought out shows the value of committee reports. It used to be understood that if a man was going into the zinc chloride business he would have to invest in pure iron tanks or go to a lot of expense to have a lead lined wooden tank. Mr. Rollins' report shows that part of this original expense is not necessary. There have been a lot of other good points brought out in this committee report. This report has brought out a fine lot of discussion and is surely not in any way objectionable. I would like to suggest that Mr. Rollins be thanked heartily for the good he has done, and I am convinced that he has done it practically alone. That is not anything against the other members of the committee, but I do not believe he has had much help from them. They have been widely scattered and they have not been able to get together much, and Mr. Rollins has been practically unaided in this work. I would like to suggest further that this committee report be passed on to the next year's committee as information. I believe it is very valuable as such and can be used to great advantage by next year's committee.

THE PRESIDENT: Do you make that as a motion?

MR. A. E. LARKIN: Yes. I will make that in the form of a motion.

MR. J. A. JOHNSON: I would like to add a few words right in the line of Mr. Larkin's remarks. Mr. Rollins is the manager of a commercial plant, and I think his position is different from most of the railroad plants, where their oil and supplies are bought by a purchasing agent, whereas the manager of a commercial plant has all that to attend to. His position not only covers the oil and material but also the

operation of the plant. I think one of the gentlemen took exception because his report covered equipment. Now the manager of a plant, if he is sent to a plant as manager and sees that his equipment is not sufficient and that he can produce good results at less cost by adding to his plant, if he does not recommend that to the one who does have authority why he ought not be manager of the plant. It is just the point of view that the man takes.

MR. F. J. ANGIER: I would like to second Mr. Larkin's motion.

THE PRESIDENT: It has been moved and seconded that Committee No. 4 be thanked for the valuable work they have done during this year and the report of this Committee be accepted as information and passed on to the Committee on the same subject next year. Is that motion as you made it?

MR. A. E. LARKIN: That is the motion.

THE PRESIDENT: All those in favor of that motion will signify it by saying AYE, contrary NO. The motion is carried.

Before we take up another paper on the program I am going to ask Mr. Schnatterbeck, editor of our magazine, to read a few remarks which he has written for our benefit.

SOME SUGGESTIONS FOR THE WELFARE OF THE ASSOCIATION.

By Chas. C. Schnatterbeck.

In reviewing the proposed amendments to the Constitution and By-Laws of our Association as proposed by Committee No. 6 considerable attention has been given to those features which seem most likely to affect the permanent success of our organization.

There are certain legal regulations and limitations which affect the revision of the constitution and by-laws of all incorporated institutions, and it is therefore necessary to exercise the greatest caution when interpreting the statutes so as to prevent legal complications and individual misunderstandings which would jeopardize the career of the A. W. P. A.

Experience, based on a careful study of corporation work in general and the investigation of the principles upon which some of our largest industrial combinations and leading technical societies have built successfully, suggests that extraordinary care should be taken in revising the Constitution and By-Laws of our Association. The members should value this privilege of voting on the proposed amendments to the Constitution and By-Laws of their Association, and freely discuss the policy outlined for the future management of the Association.

An unwise policy of procedure in building up and maintaining a technical organization will inevitably result in failure, either through an insufficient knowledge of the principles upon which the organization has been founded, or poor judgment in interpreting the language of the law bearing on the purposes of such organization, or for want of confidence in the future growth of a technical institution.

The dominant factor that will assure a successful career for our Association is enthusiastic co-operation. By this is meant the hearty support of every member. Another important factor is to put the management of the Association in the hands of gentlemen whose experience qualifies them to assume the various responsibilities, and whose personalities, incidentally, will add to the prestige of our organization. Favoritism is a human weakness, but it should not replace merit, whether the appointments are for the management of a technical organization or an enterprise whose existence depends largely on shrewd business judgment. Neither would it seem politic to elect an officer for selfish reasons, or to approve of the nomination for office of a man whose biased opinions may cause friction in the management of the Association. Therefore, members should, in justice to themselves and for the welfare of the Association, carefully consider the qualifications of those who have been proposed for election, and vote according to their own way of reasoning. Too often an official election is believed to be the ideal opportunity to put into office men who are considered good-fellows no matter what their executive qualifications may be, with the result that the work is forced on a few instead of being distributed according to the purposes of the organization. This should not be, and while it is desirable that the officers shall be congenial and magnetic in personality, experience has shown that they should also have a certain amount of business training.

The task of preparing recommendations to revise the Constitution and By-Laws of our Association, like the effort to prolong the legal life of any other corporation, is an unusually severe one. The continued growth in the membership of our Association, and its greater usefulness to railroads and those who are engaged in the timber preserving industry and kindred arts and sciences, have created conditions which make it necessary to revise our Constitution and By-Laws. In preparing the amendments to the articles granting legal life to any organization the first thought should be to anticipate future problems. A snap judgment in this regard is hazardous and may prove detrimental to the welfare of any organization no matter how meritorious its original principles may have been. Likewise too complicated provisions in interpreting the statutes may so confuse prospective members that these amendments will prevent rather than encourage the enrollment of new members.

It is to the credit of any committee that liberally interprets the incorporation law and makes recommendations that will be easily understood by the uninitiated. And when such constitution and by-laws are broad in principle, planned to meet future emergencies, and really accomplish what was intended, those responsible for their issue should be heartily complimented by the members of the Association.

Our Association has been incorporated under the liberal laws of Illinois, and it is a surprising fact that when the original articles were drawn up in 1905 there was little conception of the possible future growth in membership which would make it necessary to amend the Constitution and By-Laws seven years later, again in 1912, and again in 1915.

From a membership of 24 at the inception of our Association to the present membership of nearly 300 within a period of 10 years is certainly an enviable record—one of which any technical organization may well feel proud and for which credit is due largely to the growing faith of our best patrons—the railroads, the principal consumers of treated timber. It is also pleasing to see that there are still among us some of the original members—Charter Members as we now call them in recognition of their loyalty—and everyone of our members regardless of his grade of membership is enthused with the spirit of fraternalism which has neither territorial limits nor vocational restrictions. And there should be no class distinction if the ideal principles of our Association are properly interpreted.

Every organization needs new blood to insure it long life, and knowledge of this fact has inspired the suggestion made in the first issue of our Bulletin, about a year ago, that a Junior Membership be created for the benefit of students in our technical schools. At their graduation these students or Junior members may apply for the higher class of memberships. Junior membership might also include any young man under the age of 21 years, who is engaged in a business which is related in some way to the timber preserving industry, and he, too, when reaching his majority, may become an Associate or Corporate member of our Association.

Junior members, like Associate members, should be privileged to enjoy the same advantages as Corporate members, with the exception that they shall not vote or hold office.

The initiation fee of Junior members should be not less than $5.00, and the annual dues $7.50, in order to meet the expenses of the average membership.

The problem of chosing Honorary members is not easy to solve, but on general principles, the candidate should have the highest credentials testifying to his superior qualifications. The coveted title should also be given to the officer whose loyalty and extraordinary

services have been of great benefit to the Association. Honorary members should be privileged to vote and hold office, for the Association will need their co-operation constantly.

The Constitution and By-Laws should also state specifically that all applications for membership shall be accompanied by the initiation fee, and when acted on favorably by the Executive Committee, the successful candidates will be enrolled as members only after they have paid their dues. It should also be provided that in the event that these new members fail to pay their dues within six months after their election their membership shall cease. All members not in good standing shall forfeit the right of exercising their prescribed privileges in the Association and no printed literature shall be sent them until their indebtedness has been liquidated

To manage the enlarged affairs of the Association it is suggested that a Board of Governors be created. This Board, to be elected by the members of the Association should consist of at least five members in good standing and of proven ability. Their term of office should be on a graduated scale of 1, 2, 3, 4 and 5 years, with privilege of re-election. The Chairman of this Board should be chosen from among the members on the Board, and he should serve one year with privilege of re-election on vote of the majority of the members on the Board.

The duties of the Board of Governors should be almost identical to those of a Board of Directors in a large corporation, and while acting in an advisory capacity the members of the Board of Governors should strive to harmonize and uplift the Association's interests rather than jeopardize them by empirical decisions. In short, the Board of Governors should be capable of assuming some of the greater responsibilities that now devolve upon the Executive Committee, and all executive officers should co-operate with the membership generally in order that the Association may be assured of a prosperous future.

Another acceptable means of accomplishing greater good for the Association and its members is the publication of reliable literature descriptive of the timber preserving industry and its co-ordinate branches. Without liberal use of printer's ink it would prove a herculean task to make known the merits of any organization or creditable enterprise. The Annual Proceedings has grown in volume so rapidly that it strongly suggests the need of a vehicle of publicity which shall visit the members more frequently than once a year. This is the reason it was voted at the last Convention to publish a Bulletin, to appear as often as possible between conventions.

The Wood Preservers' Bulletin,* which is published quarterly as the official organ of the American Wood Preservers' Association, has

*Now "Wood-Preserving."

during its first year's existence created favorable comment, not alone in this country but also abroad. We now find it in the leading libraries and offices of professional and business men who are interested directly or indirectly in the conservation of our timber supply, and it is a fact that many of these readers have heretofore not known of the existence of the American Wood Preservers' Association. This statement is made frankly, and while it is true that our Association has edged its way to public attention at the annual conventions, it is also a fact that in the interval of twelve months our organization has not been mentioned in the press at large. Today the editors of our leading technical publications, as well as the great press associations that disseminate the news of the world are acquainted with the father of the Wood Preservers' Bulletin, and we believe are our friends.

To members the Bulletin should prove an invaluable means of learning from the experiences of their colleagues, the contributors to its columns. The Bulletin should also be of great assistance to members who expect to read papers at future conventions by furnishing them with up-to-date ideas. Incidentally the Bulletin will educate the public to recognize the advantage of supporting the timber preserving industry, and there is good reason to believe that this missionary work will profit the American Wood Preservers' Association and its members.

To attain the desired prestige of which our Association is worthy it is expedient to continue the publication of the Wood Preservers' Bulletin, and in addition to the Annual Proceedings to issue a Manual which shall become the recognized authority on the standards of specifications for preservatives and timber.

Every industry of any account has its representative publication which keeps the public informed of the progress being made. Surely our Association, by acting sponsor for an industry which has unlimited possibilities for the public good, should also have its technical publication. Greater progress can be attained if printer's ink is used liberally and intelligently, and the Association should not miss this opportunity to advertise its principles.

THE PRESIDENT: Mr. Schnatterbeck, in association with Mr. Angier, has given the Association very conscientious work during the past year, and I am very glad indeed to give Mr. Schnatterbeck this opportunity to make suggestions concerning our future course. I simply brought it in at this time, and I know you will pardon this digression from the program to give you an opportunity to think about it. We are going to have a Constitutional Committee later on during this meeting.

and I want to get these ideas in your minds. I want you to think about it. Read it over carefully and be ready to discuss it.

We will now take up the program in its usual order and ask Mr. Hunt to come forward.

MR. GEORGE M. HUNT: Mr. President and members of the Association, the experiments described in my paper constitute a part of an extensive series of experiments on the mechanical operating features of treating plants, the object of which is to obtain fundamental information which may be of assistance in increasing the economy and efficiency of wood-preservation. These data are not presented with the idea that from them it will be possible to tell just how long to steam timber of given dimensions and under given conditions to make the operation most efficient. Perhaps in time it may be possible to obtain sufficient knowledge to do this, but it cannot be accurately done at present. It is hoped, however, that the data as presented when used with what experience has already taught will be of some assistance in considering what takes place when wood is steamed. With the permission of the President I think it might be well to dispense with the reading of the entire paper and simply give a brief extract.

THE PRESIDENT: We will leave that to your pleasure. However, if you prefer, just analyze it by reading the conclusions.

TEMPERATURE CHANGES IN WOOD UNDER TREATMENT

By George M. Hunt,

Chemist in Forest Products, Forest Products Laboratory, Madison, Wisconsin.

Introduction.

The subject of heat conductivity in wood has a practical bearing on all pressure wood preserving processes, and it is to be regretted that it has been so little studied. In the treatment of ties and other timbers where steaming is resorted to it is important to know how rapidly the heat penetrates to the interior of the stick, or how long an exposure is necessary to bring the temperature of the interior up to the boiling point of water. This knowledge is necessary in order to economically gauge the time employed in steaming processes, and is also important in applying creosote by the boiling process.

The study of this question constitutes a part of the work which the Forest Products Laboratory has had under way for the past three years on the operative features of treating plants, the results of which have from time to time been presented before this association.*

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*See Proceedings of this Association, 1912 (page 159), 1913 (page 288), and 1914 (page 323).

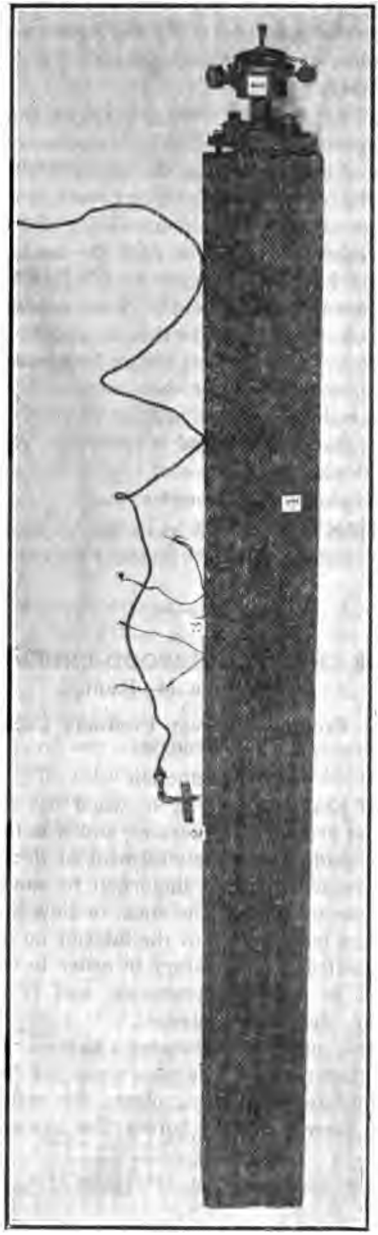


Fig 1 —Tie with Apparatus Attached.

1. Head of resistance thermometer attached to bed plate.
2. Apparatus for obtaining interior pressures.
3. Wires from thermoelectric cartridges.
4. Point to which tube of thermometer penetrates.

The author wishes to acknowledge his indebtedness to Mr. E. C. Sparver who made most of the experiments and assisted in the preparation of this paper. Acknowledgment is also due the Chicago, Milwaukee and St. Paul, the Chicago and North Western, and the Illinois Central Railroads for furnishing the ties for the experiments.

Material Used.

Sawed maple, red oak, lobolly pine, and hemlock ties 6"x8"x8½' were used. These species were selected because they are commercially valuable representatives of ring-porous and diffuse-porous hardwoods, and slightly resinous and highly resinous conifers. Both green and seasoned ties were used as shown in Table 1. The loblolly pine was cut in Mississippi and the hemlock in northern Michigan. The green maple and red oak came from Wisconsin, and the seasoned from northern Michigan. All but the hemlock ties were free from bad checks and other serious defects.

Nine ties of each species were used, except in the case of the hemlock, which were so badly checked that but four good ties could be obtained from the lot.

Apparatus

The treatments were made at the laboratory in a 3½'x11' treating cylinder, which is equipped with steam coils, thermometers, and pressure and vacuum gauges necessary for these tests. A detailed description of this cylinder may be found in Forest Service Bulletin 126, "Experiments in the Preservative Treatment of Red Oak and Hard Maple Cross-Ties."

Two thermometers, one indicating and one recording, were used for obtaining the temperature in the cylinder, and a platinum resistance thermometer with a whipple indicator for obtaining the temperature within the tie. In the resistance thermometer, a change in temperature produced a change in the electrical conductivity of a coil of platinum wire. The temperature was read direct on the whipple indicator, which was calibrated in degrees of temperature rather than ohms resistance. The platinum coil was encased in a glazed porcelain tube about 26 inches long and 7-8 inch in diameter. One end of the tube was closed and the other end was sealed in a metal head steam and water tight. Insulated connecting wires from the coil to the indicator were conducted to the shell of the retort through a flexible lead tube.

A 1¼-inch hole was bored into the end of the tie along its axis, to a depth of over 26 inches and an iron bed plate with a hole in the center was then fastened to the end of the tie. The thermometer was inserted through this hole into the tie, and fastened to the bed plate.

In a number of runs, the thermometer readings were checked by the use of thermoelectric cartridges. Two or three cartridges set for

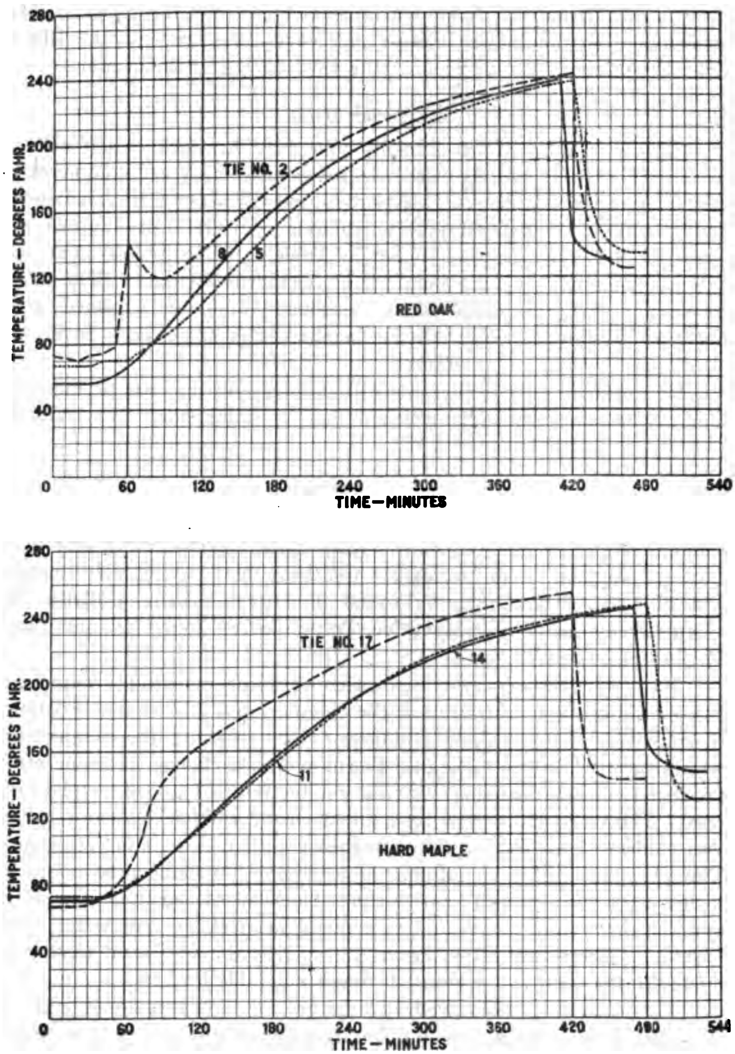


Fig. 2.—Interior temperatures, red oak and hard maple, steamed at 20 pounds gage pressure (259° F.).

different temperatures were inserted in as many holes in a tie, and thoroughly insulated so that no heat could reach them except by conduction through the wood. The results obtained were reasonably close to the thermometer readings and led to the conclusion that the influence of heat conduction along the thermometer tube could be disregarded.

Figure 1 shows a tie with thermometer, cartridges, and pressure apparatus attached. This tie has been sawed through at the point to which the thermometer tube penetrates.

Method of Conducting the Work.

Preparation of Ties for Treatment:

The oven-dry weight per cubic foot was first determined for each tie from a 2-inch moisture disc cut from one end of the tie. This, with the volume of the tie, and its weight at any given time, allowed its moisture content at that time to be calculated. The pressure and temperature apparatus were then attached and the tie was ready for treatment. In the majority of runs a handful of steel wool was placed in space between the bulb and the wood.

Outline of Treatments Given:

The heating media used were saturated steam at atmospheric pressure (212° F.), saturated steam at 20 pounds pressure (259° F.), and hot creosote at atmospheric pressure. In most of the runs the creosote was used at 212° F., but a few runs were made at about 185° F. The treatments given are outlined in Table 1.

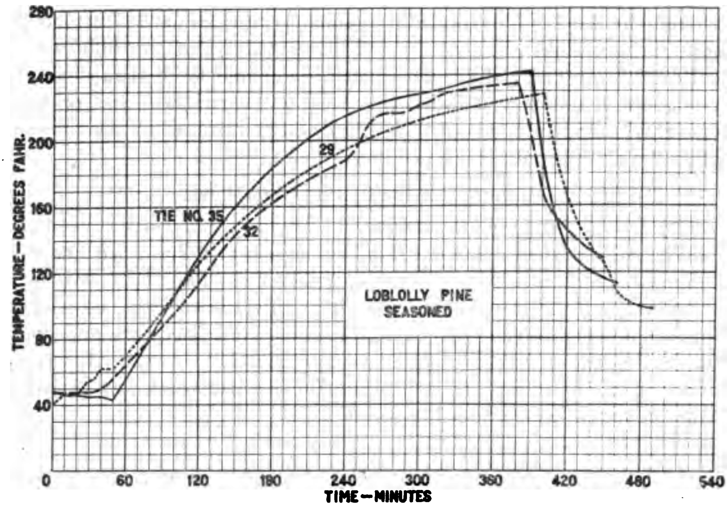
TABLE 1.—MATERIAL USED AND TREATMENT GIVEN.

Species of wood	Number of ties treated in each Heating medium			
	Saturated steam 20 pounds per sq. in.	Saturated steam atmospheric pressure	Creosote 185° F.	Creosote 212° F.
Red Oak	3	3	0	2
Hard maple	3*	3*	1	2
Loblolly pine**	3	3	1	2
Eastern hemlock**	2	2	1	0

*One seasoned tie—Moisture contents of individual ties given in Table 3.
**All seasoned ties—Moisture contents of individual ties given in Table 3.

Method of Heating:

In the steam treatments, the steam was applied at the specified pressure, and the temperature of the cylinder brought up to its maximum as quickly as possible. In the 20-pound steam treatments, the theoretical temperature of 259° was not attained in the cylinder in the runs on lobolly pine, which were the first made at this pressure. This



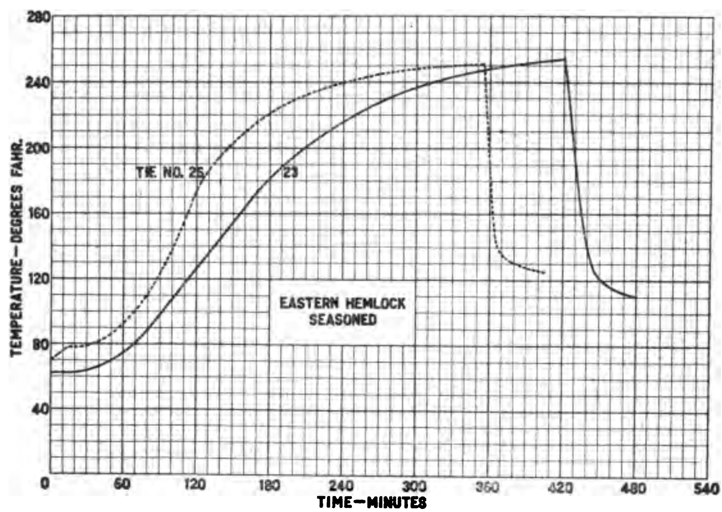


Fig. 3.—Interior temperatures, loblolly pine and eastern hemlock, steamed at 20 pounds gage pressure (259° F.).

was probably due to the presence of air in the cylinder. In the later runs a vent in the cylinder was left open for a few minutes at the beginning of the treatment to allow the air to escape, and in these runs the theoretical temperature was practically obtained in every case. In the creosote treatments, the oil was applied and maintained at the specified temperature throughout the time of treatment.

In all treatments the heating was continued until the rise in temperature within the tie was not more than 1.8° F. (1° C.) in 10 minutes but in most runs the heating was continued considerably beyond this point. At the conclusion of the heating period a vacuum of 26 inches was applied for an hour.

Records:

The temperature and pressure of the heating medium and of the interior of the tie were read and recorded at 10--minute intervals. The weight of the tie was taken immediately before and after treatment, and usually one-half hour and 24 hours after treatment.

In figures 2 to 7, the rise in interior temperature for the individual ties is shown graphically, the temperature within the tie and time after admitting the heating medium being used as co-ordinates. Other temperature data are given in Table 2.

Discussion of Results.

Interior Temperatures:

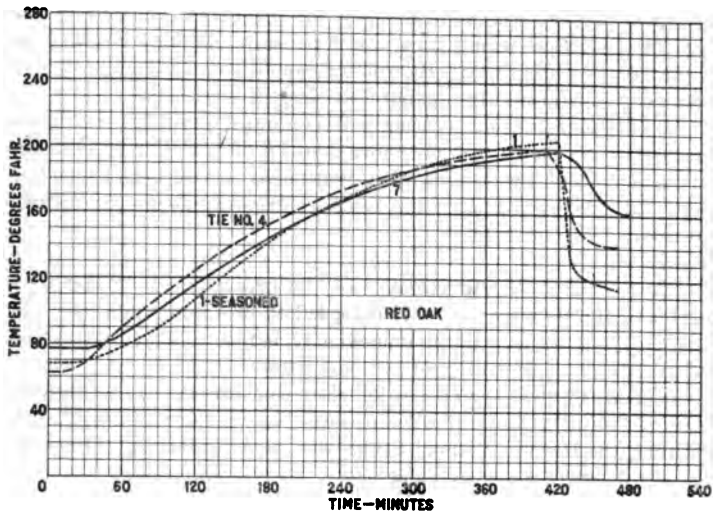
On the whole the results were very concordant when the character and variability of the material are taken into consideration. During about the first 30 or 40 minutes of heating, but few of the ties showed an appreciable rise in interior temperature. This time was required for the heat to penetrate to the thermometer bulb. After the heat had penetrated to the interior, a steady rise in temperature began, which was most rapid at first, and gradually became slower as the heating proceeded until at the end of the heating period it dropped in most cases to considerably less than 1.8° F. (1° C.) in 10 minutes.

In no case did the maximum interior temperature of the ties quite attain that of the heating medium, although the heating was continued for from 5½ to 8 hours.

In the 20-pound steam treatment, the time required to bring the interior temperature of the ties to 212° F. varied from 2 hours and 45 minutes in the case of one tie to 5 hours in several others. The average time for all the ties was about 4 hours and 20 minutes. In the atmospheric steam and the hot creosote treatments, the interior temperatures did not reach the temperature of boiling water except in one case as shown in Table 2.

Effect of Vacuum:

The point at which heating was discontinued and the vacuum started is shown by a sudden change in the temperature curve. At this



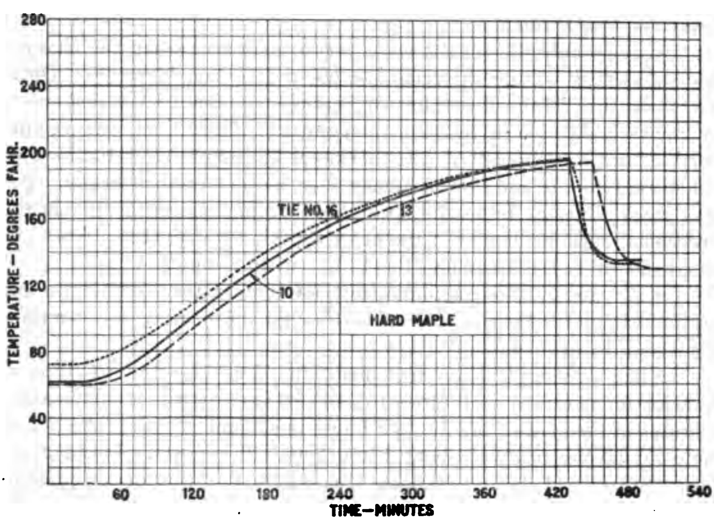


Fig. 4.—Interior temperatures, red oak and hard maple, steamed at zero gage pressure (212° F.).

point the temperature of the tie was considerably above the boiling point of water in a 26-inch vacuum (which is about 123° F.) and the application of the vacuum caused the water in the tie to boil rapidly. Since no further heat was being supplied to the tie, and heat was being rapidly absorbed by the boiling water, the temperature of the tie dropped very quickly. This is shown by the steep slope of the curve after the sudden change. The slope becomes less steep as the vacuum is continued, for as the temperature dropped, vaporization became slower, a smaller amount of heat was absorbed from the tie, and its temperature dropped less rapidly.

Rate of Increase of Interior Temperature:

The rate of increase of the interior temperature was greatest in the treatments with 20 pounds steam, and least in the treatments with creosote at 185°. This is shown by a comparison of the curves in figures 2 to 7. A close comparison of the curves in figures 4 to 7 shows that the rate of increase was slightly greater with steam at 212° F. than with creosote at the same temperature. This is especially noticeable in the treatment of the seasoned ties as the loblolly pine curves show.

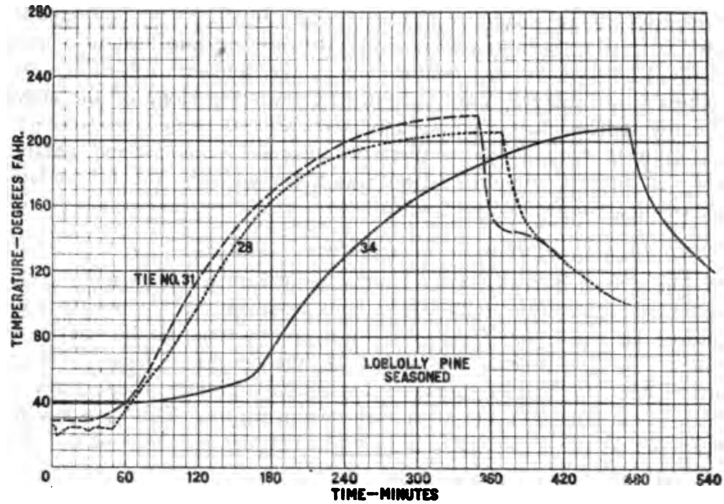
In general, the seasoned ties heated more rapidly than green ties. There are two apparent reasons for this. In the first place, it was necessary to heat the large amount of moisture in the green ties, as well as the wood itself. In the seasoned ties the amount of moisture to be heated was much smaller. In the second place, the absorption by the seasoned ties of the hot condensed steam would cause their interior temperature to increase more rapidly. In the creosote treatments the absorption of hot creosote was greater in the seasoned ties.

Under the conditions of the experiment, no appreciable difference in the rate of increase of temperature due to difference in species could be determined.

Effect of Treatment on Physical Condition of the Ties:

The effect of the steaming and vacuum treatment on the moisture content of the ties is shown in Table 3. In the steaming treatments the green ties invariably showed a reduction in moisture varying from 1 to 15 per cent. In the seasoned or partly seasoned ties the results were somewhat conflicting, some ties showing a gain in weight and some showing a loss.

In the non-resinous ties the loss in weight can safely be assumed as being chiefly due to loss of moisture, but in the case of the seasoned loblolly pine, when a loss in weight is shown it is undoubtedly due in part to the distillation of resin by the steam. The original moisture determinations on loblolly pine are also subject to a slight error on account of the loss of resin while drying the discs. For this reason,



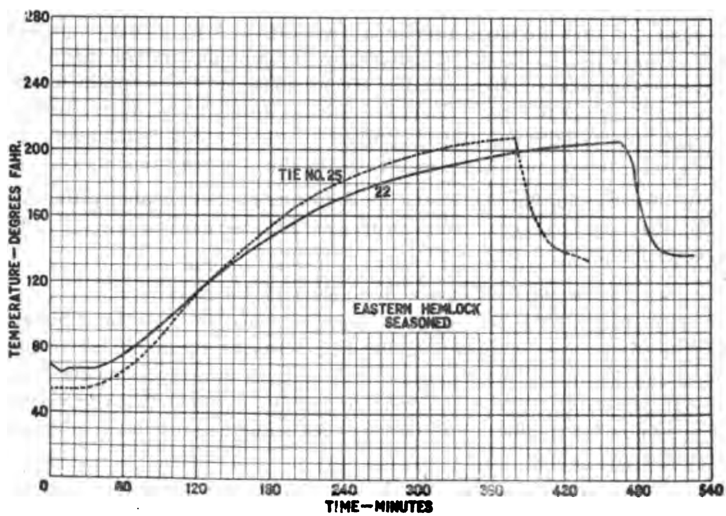


Fig. 5.—Interior temperatures, loblolly pine and eastern hemlock, steamed at zero gage pressure (212° F.).

some of the figures in Table 3 for moisture content of loblolly pine before treatment may be a little high.

All but one of the ties continued to lose weight after treatment, the loss varying from 1 to 8 per cent. of the dry weight of the wood, during the first 24 hours after treatment. Creosoted ties lost less than steamed ties.

In the 20-pound steam treatments the green red oak and maple were very badly checked, but the seasoned ties were not so seriously affected. In the other treatments with creosote and with steam at atmospheric pressure, checking was not serious in either green or seasoned ties.

Summary.

The results of these experiments may be summarized as follows:

1. In most of the ties there was no appreciable rise in interior temperature during the first 30 or 40 minutes.

2. The interior of the ties never quite attained the temperature of the heating medium.

3. In the treatments with steam at 20 pounds pressure, the time required for the interior to reach 212° F. varied from $2\frac{3}{4}$ to 5 hours, the average being 4 hours and 20 minutes.

4. Upon the application of the vacuum the interior temperature fell very rapidly.

5. The rate of increase of interior temperature was greatest in the treatments with steam at 20 pounds pressure, and least with creosote at 185° F.

6. The rate of increase of interior temperature was slightly greater in the treatments with steam at 212° F. than with creosote at the same temperature, at zero gage pressure.

7. Seasoned ties heated more rapidly than green ties.

8. No appreciable difference in the rate of increase of interior temperature due to difference in species could be determined.

9. In the steam and vacuum treatments, green ties always showed a loss of moisture while seasoned ties sometimes showed a gain and sometimes a loss.

10. Practically all the ties continued to lose weight during the first 24 hours after treatment. Creosoted ties lost less weight during this period than steamed ties.

11. In the treatments with steam at 20 pounds pressure, the green ties were badly checked while seasoned ties were not so seriously affected. In the other treatments, none of the ties were seriously checked.

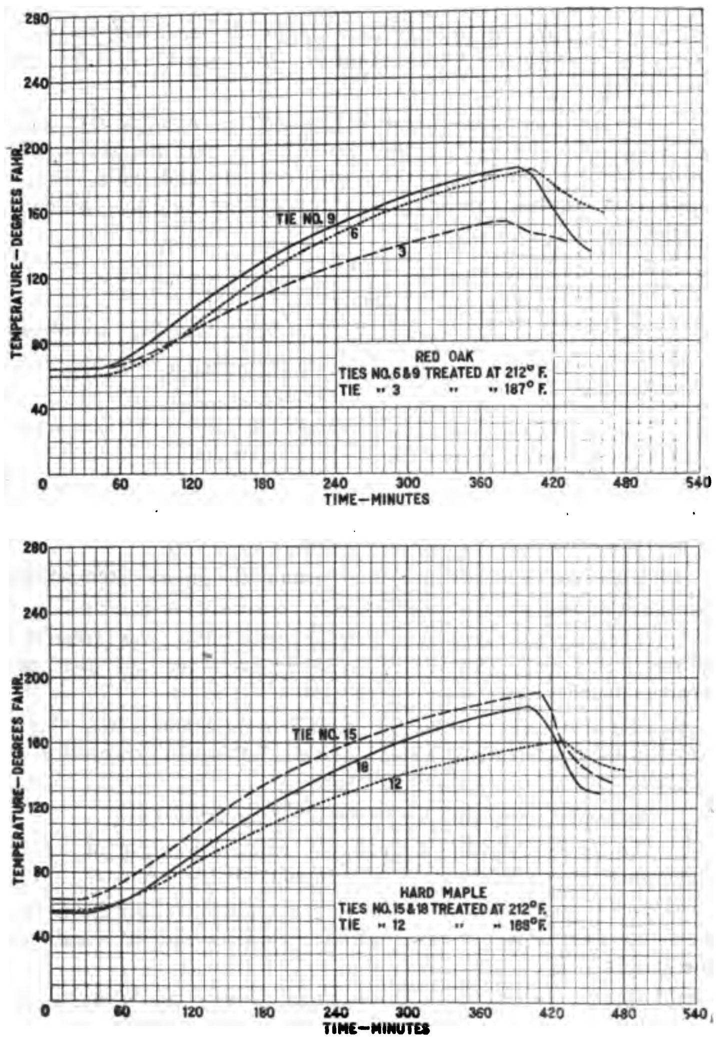


Fig. 6.—Interior temperatures, red oak and hard maple, heated in creosote.

TABLE 2—TEMPERATURE DATA ON INDIVIDUAL TIES.

Species.	Tie No.	Heating medium.	Temperature of medium.	Initial temperature of tie.	Temperature of tie at end point.*	Maximum temperature of tie.	Total time of heating.		Time required to reach end point.*		Time required to reach 212° in tie.	
			°F.	°F.	°F.	°F.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min
Red oak		Steam, 20 lbs. pressure	258	73	227	243	7	00	5	20	4	20
" "	5		259	67	230	238	7	00	6	10††	5	00
" "	8		259	57	229	239	6	50	5	50	4	50
Hard maple	11		258	73	232	247	8	00	6	10	5	00
" "	14		258	72	226	244	7	50	5	50	5	00
" "	17†		259	67	240	254	7	00	5	20	4	00
Loblolly pine	29†		231	41	216	228	6	40	5	10	5	00
" "	32†		236	47	217	234	6	20	4	30	4	20
" "	35†		248	48	226	242	6	35	4	40	3	50
Eastern hemlock	23†		259	63	245	253	7	10	5	40	3	50
" "	26†		258	70	239	252	6	00	3	55	2	45
Red oak	1†	Steam atmospheric pressure	212	68	198	203	6	50	5	50		
" "	4		212	63	181	200	6	50	4	30		
" "	7		212	77	181	199	7	00	4	50		
Hard maple	10		212	62	181	196	7	10	5	20		
" "	13		212	60	176	195	7	30	5	20		
" "	16		212	73	182	198	7	10	5	20		
Loblolly pine	28†		215	25	190	206	6	10	3	50		
" "	31†		218	28	209	216	5	50	4	40		
" "	34†		216	39	200	208	7	55	6	45**	5	00
Eastern hemlock	22†		212	69	186	206	7	45	4	55		
" "	25†		212	54	196	208	6	20	4	50		
Red oak	6	Creosote	212	60	170	184	6	40	5	20		
" "	9		213	64	172	186	6	40	5	20		
Hard maple	15		212	64	172	190	6	50	5	00		
" "	18		213	55	174	182	6	40	5	50		
Loblolly pine	33†		212	73	191	199	6	10	5	10		
" "	36†		211	74	190	202	6	00	4	30		
Red oak	3		185	64	141	152	6	10	5	00		
Hard maple	12		188	56	139	162	7	00	4	50		
Loblolly pine	30†		187	73	146	165	6	20	4	30		

*The end point was the time at which the rise in temperature of the interior of the tie ceased to be greater than 1.8° F. (1° C.) in 10 minutes.

**Thermometer bulb later found to have been in large knot.

†Seasoned tie.

††Heating interrupted to make repairs.

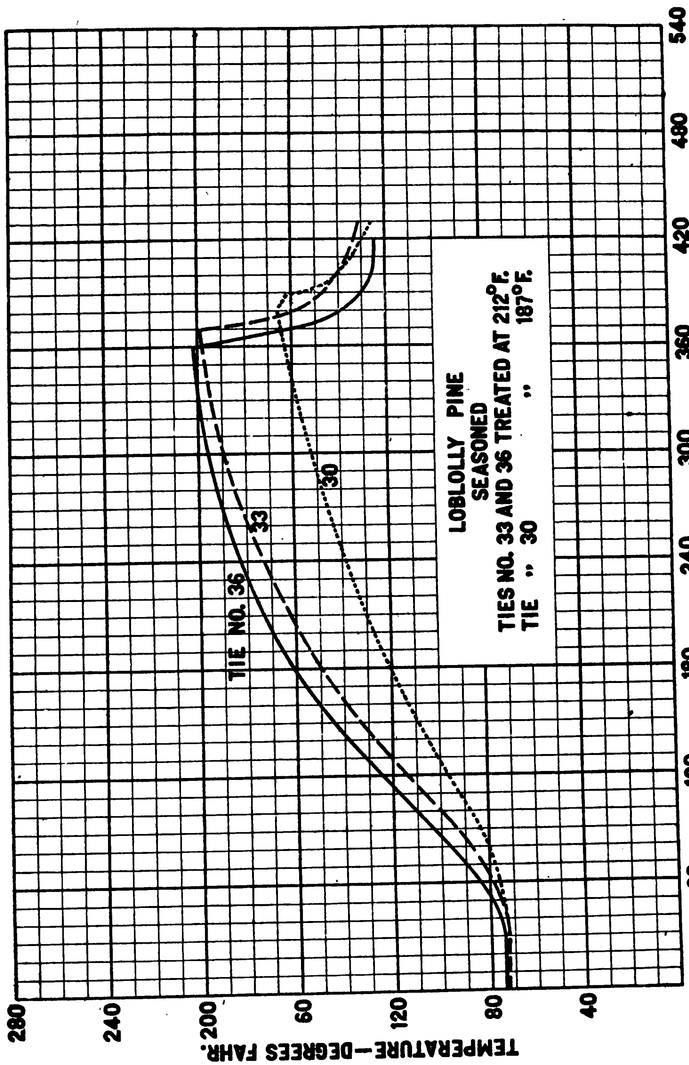


Fig. 7.—Interior temperature, loblolly pine, heated in creosote.

TABLE 3.—EFFECT OF TREATMENT ON MOISTURE CONTENT.

Species	Tie No.	Heating medium.	Moisture content*		
			Before treatment.	Immediately after treatment.	24 hours after treatment.
			Per Cent.		
Red oak............	2	Steam 20 pounds per sq. in.	65	52	50
" "	5		67	58	56
" "	8		69	54	54
Hard maple.........	11		80	71	63
" "	14		66	61	59
" "	17		18**	22	15
Loblolly pine........	29		46**	41	39
" "	32		26**	27	24
" "	35		47**	45	43
Eastern hemlock.....	23		38**	34	31
" "	26		21**	19	17
Red oak............	1	Steam atmospheric pressure	28**	29	27
" "	4		99	89	88
" "	7		89	87	83
Hard maple.........	10		52	49	45
" "	13		95	89	84
" "	16		45	44	41
Loblolly pine........	28		29**	23	19
" "	31		34**	30	27
" "	34		39**	42	37
Eastern hemlock.....	22		38**	38	35
" "	25		27**	27	25
Red oak............	6	Creosote	60	?***	?***
" "	9		72	"	"
Hard maple.........	15		70	"	"
" "	18		79	"	"
Loblolly pine........	33**		44	"	"
" "	36**		15	"	"
Red oak............	3		65	"	"
Hard maple.........	12		49	"	"
Loblolly pine........	30**		31	"	"

*Based on oven-dry weight of wood.
**Seasoned tie.
***Moisture content unknown, due to absorption of undetermined quantity of creosote.

THE PRESIDENT: We have a very interesting paper here on this subject which we would like to have fully discussed. Mr. Rollins will give us his written discussion first.

DISCUSSION ON TEMPERATURE CHANGES IN WOOD UNDER TREATMENT.

By H. M. Rollins.

Mr. Hunt's paper is a very valuable contribution to the science of wood-preservation. It seems that Mr. Hunt is original in the conception and execution of this series of tests, and, so far as 6x8 ties are concerned, has determined the necessary length of steaming period required to produce a boiling temperature in the center of the tie, which, according to his results, shows an average period of 4 hours and 20 minutes. This approximates very closely the practice, or what was originally the practice, of one of the oldest tie-treating railroads in this country, which was to steam all ties for a period of 4 hours at 20 pounds gage pressure.

One of the most interesting possibilities suggested by Mr. Hunt's paper is that it is possible, knowing the cylinder temperature while steaming, to know the interior temperature of the wood at any desired time.

It would seem that the interior tie temperature at any time during the steaming period approaches very closely a certain per cent. of the cylinder temperature, and this relation appears to be constant for all cylinder temperatures, *i. e.* the interior tie temperature at any time is a fixed per cent. of the cylinder temperature, no matter what that cylinder temperature may be.

Take the records of the green ties in Mr. Hunt's test, under steaming both at 20 pounds gage pressure and at atmospheric pressure (Figs. 2 and 4), and you will find some very interesting facts, namely, that at the end of the second, third and fourth hours of steaming the relation of interior tie temperature to cylinder temperature is approximately the same for both pressures, at the end of the fifth hour they fall within 1 per cent. of each other, and at the end of the sixth hour and 6 hours and 50 minutes period they are practically coincident.

You will note by referring to Fig 2, ties 2 and 5, that temperature curves are irregular, which indicates an interruption in the steaming of these ties during the first two hours, and may we not believe that had these curves been regular, that the relations above referred to would have been as nearly coincident at the second, third and fourth hour periods as they are at the end of the fifth, sixth and 6 hours and 50 minutes periods.

Assuming this to be the case, it would be an easy matter to construct a curve which would represent interior temperatures at all times when the cylinder temperature was known.

With the information supplied by Mr. Hunt's paper, this could only apply with positive knowledge to 6x8 ties. As to how closely it would hold with larger timbers is matter for further investigation, and it seems that further investigation along these lines would yield a fund of useful information.

The effect of steaming on the weight of seasoned ties, as determined by this test, corresponds very closely with results that have been obtained at treating plants; 6x8x8′ pine ties, steamed for a period of 4 hours at a pressure of 20 pounds and subsequently subjected to a vacuum of 22 inches for a period of 1 hour in a cylinder 6′x112′, averaged a gain of 2 pounds per tie.

The fact that seasoned material absorbs heat much more quickly than green material in a treating cylinder is well established and is often illustrated in plants where both green and seasoned material are steamed, it taking much more heat to produce the desired cylinder temperature with a seasoned load than with a green one.

The rapid fall of the interior temperature under a vacuum, as shown by the curves for all the ties and more particularly tie No. 1, is surprising.

I can readily understand the rapid fall in cylinder temperature under vacuum and in the outside portions of the tie; but with a tie which has been surrounded with a heating medium for 7 hours, whose temperature was 212° F., to lose from its center in 10 minutes under vacuum all that increase in temperature which it had gained in the last 4 hours and 20 minutes of steaming, shows a wonderful increase in the heat conductivity of the wood, or something else.

This seems to indicate that the boiling of the moisture took place in every cell in the tie from the outside to the center, for it is hardly probable that the necessary heat for boiling the moisture in the outer cells could have been supplied from the cells in the center of the tie by conduction in so short a space of time. If the moisture in the center of the tie actually boiled then the escaping vapors must have opened up thoroughly certain passages in the tie from the center to the outside surface.

The discussion of this particular point approaches very closely a subject which is of considerable importance to the plant operator and to the engineer who writes specifications for timber treating.

It is regrettable that in making this test Mr. Hunt did not use his cylinder steam coil while the cylinder was under vacuum, for the subject I have in mind is cylinder temperature under vacuum.

TABLE SHOWING RELATION OF INTERIOR TIE TEMPERATURE TO CYLINDER TEMPERATURE, WHERE GREEN TIES WERE STEAMED. (DATA TAKEN FROM FIGURES 2 AND 4 IN MR. HUNT'S PAPER.)
GREEN TIES STEAMED AT 20 POUNDS GAGE PRESSURE.

TIE NUMBER	INTERIOR TEMPERATURES.—HOUR.					
	2nd	3rd	4th	5th	6th	6h. 50m.
2	135	177	205	223	234	241
5	105	151	187	211	229	237
8	116	162	195	217	230	239
11	116	154	189	215	230	240
14	114	156	190	212	228	237
Average at end of each hour	117.2	160	193.2	215.6	230.2	238.8
Per cent. interior temperature was of cylinder temperature at end of each hour	45.3%	61.5%	74.7%	83.4%	89%	92.4%

GREEN TIES STEAMED AT ATMOSPHERIC PRESSURE.

TIE NUMBER	INTERIOR TEMPERATURES.—HOUR.					
	2nd	3rd	4th	5th	6th	6h. 50m.
4	124	153	174	186	197	200
7	116	145	167	183	193	198
10	102	135	159	176	189	195
13	95	127	153	172	184	192
16	110	140	162	179	189	195
Average at end of each hour	109.4	140	163	179	190.4	196
Per cent. interior temperature was of cylinder temperature at end of each hour	51%	66%	76.8%	84.4%	89.8%	92.4%

NOTE red oak ties Nos. 2 and 5 in Fig. 2, that curves are irregular, which indicates there was an interruption in the steaming during the first two hours. This no doubt influenced the relation of interior temperature to cylinder temperature for the first two or three hours, after which time it will be noted the comparative relations are very close.

A large number of specifications for timber treating state that the cylinder temperature under vacuum following the steaming period must at all times be above the boiling point corresponding to the vacuum.

One issued recently by a northern city calls for a 24-inch vacuum for a period of 3 hours, and the temperature in the cylinder shall at all times be above the boiling point corresponding to the vacuum.

After considerable thought on this problem I have come to the conclusion that the engineer who writes this clause into a specification is calling for a cylinder condition that is a practical impossibility, and I believe, with a large cylinder a physical impossibility, a test at this particular point would prove decidedly interesting and would furnish a basis for establishing some integrant ratio between heating coil, surface and cylinder volumes and would also assist in determining if the heating coil performs any other useful function in timber treating than the heating of the preservatives.

THE PRESIDENT: This is an excellent discussion of the paper by Mr. Hunt. Mr. Card will present a written discussion on the same subject.

DISCUSSION ON STEAMING TIES.

By J. B. Card.

It is not my intention to offer any criticism on this able and interesting paper of Mr. Hunt's, but to set before you the results of some experimental work which I have done during years past in repeated attempts to find a way in which green ties could be properly treated by first steaming for various lengths of time and then applying a vacuum to reduce the moisture content. Nearly all of my work was done under the supervision of Mr. O. Chanute, a past member of this Association, whom you all knew. And it may be readily seen by studying the following figures that we succeeded in injecting only about one-half the amount of solution into steamed green ties that we did in seasoned ties.

Tests on green hemlock ties, weighing 57½ pounds per cubic foot, steamed at 20 pounds pressure for 3 hours, vacuum 24 inches, 2 hours, heat carried in coils during both steam and vacuum period, show a loss of 4½ per cent. of their weight. Dry ties in same runs, weighing 40 pounds per cubic foot, gain 1.3 per cent. of their weight. The green ties absorbed 6½ pounds of zinc solution per cubic foot, dry ties 11½ pounds per cubic foot.

Some steaming tests show that green hemlock ties, weighing 57 pounds per cubic foot, gain from 1 to 2½ per cent. in weight with 20

pounds of steam for 3 hours. Other tests show that ties of the same weight lose from 1 to 2½ per cent., no vacuum being used. In the runs where no vacuum was used the ties were returned to the cylinder after weighing, steamed again for half an hour and then a vacuum of 24 inches applied from one to two hours. The green ties would now lose from 3.8 to 5 per cent. All attempts to obtain a good treatment failed, the absorption being from 9 to 11 per cent. of their weight.

In steaming green hemlock ties for 5 hours at 20 pounds pressure and from 1 to 2 hours vacuum of 24 inches results show a loss in weight from 1.6 to 5.7 per cent. of their weight, which is not sufficient to insure a good penetration.

Beech ties received in April, weighing 55 to 60 pounds per cubic foot, absorbed from 7 to 11 per cent. of their weight with 3½ hours steam and 1 hour vacuum of 24 inches. The same class of ties when yarded for 5 months weigh from 48 to 53 pounds per cubic foot and absorb from 25 to 30 per cent. of their weight. The German practice in treating beech ties is to season them until their weight is 51.3 pounds per cubic foot. The French weight for beech is 46.7.

Pine ties shipped to us from the Seaboard Air Line from North Carolina, Virginia and Georgia, cut in September, treated in October, absorbed from two to eight times as much solution as other ties cut in April and shipped from the same sections and treated in May.

The Illinois Central Railway on October 28, 1890, shipped us a car of mixed ties, some green and some dry. They were steamed at 20 pounds pressure for 3½ hours and 1 hour vacuum. The following is the average absorption:

Kind of Wood.	Weight Per Cu. Ft.	Solution Absorbed: Pounds Per Cu. Ft.	Gain: Per Cent.
Pin Oak	63.1	6.4	10.1
Red Oak	56.1	10.4	18.6
Black Oak	55.5	10.3	18.5
Water Oak	54.3	11.6	21.4
Beech	55.1	5.2	9.35
Sweet Gum	48.4	2.4	5.0
Maple	42.3	24.0	57.5
Black Gum	41.7	14.7	35.5
Cypress	42.2	25.9	61.3
Red Elm	45.4	20.0	44.0
Hickory	62.7	2.9	4.7

The average absorption of black oak ties, weighing 49.6 pounds per cubic foot, shipped to us by the P., C., C. & St. L. Ry., steamed 3 hours, vacuum 1 hour, was 34.6 per cent. or 17.1 pounds per cubic foot.

Jack oak and water oak, shipped to us by the C. & E. I. Ry., weighing 55 pounds per cubic foot, steamed 3 hours, vacuum 1 hour, absorbed 15 per cent. or 8.2 pounds per cubic foot. Scale weights at the Mt. Vernon plant show that the same class of ties, weighing 50.4

pounds per cubic foot, absorb as high as 33.1 per cent. or 16.6 pounds per cubic foot with 3 hours steam and 1 hour vacuum.

After numerous other attempts to season green ties by steaming and vacuum my company abandoned this practice in 1902 and since then all ties have been yarded and allowed to air season. It is possible that green ties, if given a prolonged steam and vacuum period, with the heating coils in operation, could be made to take a requisite amount of solution, but the cost would be higher than air-seasoning and the strength of the wood injured.

THE PRESIDENT: This is certainly fine to see coming in here the written discussions of these papers. It shows that the papers that we sent out have been given thorough study and that you have taken the trouble to write the discussion.

MR. W. W. LAWSON: I have in mind some very good information about steaming ties. I think the work was done under the direction of Dr. von Schrenk, at St. Louis. I do not remember when the results of the tests were published, but tests were made on several different kinds of ties to find the effect of vacuum and different steam pressures, and it might prove instructive to resurrect this paper and incorporate it in the report of our Proceedings. I am sure it would be interesting.

THE PRESIDENT: I think possibly the paper that Mr. Lawson refers to is one issued by the Government, and possibly the work was carried on by Professor Hatt of Purdue. I cannot recall the publication, but probably Mr. Fulks or one of the Madison laboratory men could supply the number of that publication so that we could include it.

MR. CLYDE H. TEESDALE: Circular 39 of the Forest Service.

THE PRESIDENT: We are very glad to get hold of this information. We would like to hear from others on this subject.

MR. EDW. F. PADDOCK: Mr. President, it has occurred to me in looking over the portion of this paper relative to steaming the last paragraph says: "In the treatments with steam at 20 pounds pressure green ties were badly checked, while the seasoned ties were not so seriously affected. In the other treatments none of the ties were seriously checked." I noticed that in those curves representing treatments where serious checking occurred the irregularities of the curves were a good deal greater than they were in the treatment where checking was not so great. This, I should say, might be caused by the opening up of checks in the wood, thus allowing the admission of steam near the center of the tie. If Mr. Hunt can give us any information on that I will be

glad to hear from him. There are one or two other questions I would like to ask. He speaks of the installation of a pressure gage for the measurement of pressures in the interior of the ties during the treatment but gives no results from it. I am wondering if there were any results that were worth reporting. Further, I would like to ask Mr. Hunt if there was any determination made of the amount of heartwood and sapwood in those ties, whether there was any record made as to those amounts.

MR. GEO. M. HUNT: It seems beyond doubt that the checking in the ties did have some effect on the rate of the increase of temperature in the interior. I do not think, however, that the effect is sufficient for anyone to tell from the curves which ties checked during treatment and which did not. Tie No. 2 in Fig. 2 is a possible exception. With regard to the pressure apparatus that was used, that was merely a continuation of work that was reported in the 1913 Proceedings in a paper by Mr. Winslow. The results were not considered pertinent to the subject of this paper and were not included in it. They corroborated in a general way, however, the results reported by Mr. Winslow. In regard to the amount of heart and sap, that was observed on all the ties, but its effect on the rise in temperature could not be determined. You will note that even the effect of the species of wood on the rise of the temperature could not be determind. There are so many factors which cannot be controlled in the tie, such as checking and different characteristics of the wood, that it is not possible to determine the effect of each one without a very extensive series of experiments.

MR. EDW. F. PADDOCK: I notice that in the photograph shown the tie has been sawed. Was any determination made as to the amount of penetration or absorption that occurred at that point? I am speaking now from the open tank man's point of view, and it might be of interest not alone to me but to the pressure people in order to get some definite data as to the initial absorption in filling the treating cylinders.

MR. GEO. M. HUNT: These experiments were carried out principally to find out what takes place during steaming, and were not carried further to see what effect the treatment had on absorption and penetration. That is reserved for further experiment. In the case of the ties that were creosoted we made no determination of absorption and penetration.

MR. A. M. LOCKETT: If Mr. Hunt intends to carry these experiments further I would suggest that he endeavor to ascertain the effect upon the rise in temperature of the wood which takes place as a result of the wood being subjected to a vacuum before admitting the steam.

By reason of the low conductivity of air it would seem reasonable to me that if the wood is previously subjected to a vacuum and the

steam admitted while the vacuum is on the retort the increase in temperature of the wood would be much more rapid, and, therefore, the steaming time much reduced.

I have desired to ask the manager of a wood-preserving plant to make this experiment, but, I believe, that more information would be obtained if it were done in a laboratory, because if the experiment is made in the operation of a plant without the thermometers inserted in the wood the only apparent effect would be a more rapid consumption of steam, the effect of which might escape the closest observer. Such a practical test would be instructive if a steam meter were placed upon the steam pipe, because if the wood absorbs the heat more rapidly this meter would record the more rapid consumption of steam. I do not believe that subjecting the timber to a vacuum before steaming would reduce the quantity of steam required to raise the temperature of the wood, but the length of time for steaming might be materially reduced and the output of the plant increased.

I might add that in reducing the time of steaming there would be an appreciable saving in steam, since the radiation and loss of heat by this means would be correspondingly reduced.

MR. GEO. M. HUNT: No.

MR. A. E. LARKIN: I would suggest that it would be interesting.

THE PRESIDENT: This is an excellent subject, and so far as I know none of us has ever practiced the use of vacuum previous to steaming. I want to thank Mr. Lockett for this suggestion, and I certainly will as far as I can in a practical way—an experimental cylinder way—try it out. I hope Mr. Hunt, however, will make an effort to try it out in his experimental cylinder, where he has very much greater control than we can possibly have in the actual treating plant with the experimental cylinder equipment that we have. I would like to ask one or two questions of Mr. Hunt on this subject. First, do you feel that the rapid drop of the temperature in these timbers after vacuum or during vacuum was an actual condition of the timber, or do you think that there is a possibility of the instrument by which you were measuring the temperatures being subjected to conditions that did not or were not conveyed through the wood fiber? In other words, do you feel that you finally solved the method or learned how to protect your thermometer bulb so that it reflects actual conditions as transmitted through the wood fiber? Just one more question I would like to ask that seems to me quite pertinent to this point, and that is in regard to the kind of timber to be used in these experiments. It would have been of great interest to have these tests carried on with a timber like Douglas fir or hemlock rather than loblolly pine or timbers of the southern woods that

are so easily permeable. I would like to ask an explanation of those two points, Mr. Hunt?

MR. GEO. M. HUNT: In regard to the first question on the effect of atmospheric conditions on the thermometer, I do not believe they have any effect at all. It was an electrical thermometer and the temperature was measured by the electrical resistance of a platinum coil. The atmospheric conditions would not affect that.

Furthermore, it is theoretically correct to assume that such a sudden drop of temperature would take place on account of the sudden boiling of the water when you reduce the pressure. When you reduce the boiling point of that water from 212° F. to 123° F., about 90° within 10 or 15 minutes, the water necessarily boils very rapidly and in boiling absorbs a large quantity of heat. Since no heat is being supplied except what is contained in the wood the temperature of the wood must fall rapidly and in proportion to the rapidity of the boiling.

I do not feel that we have entirely solved the problem of measuring internal temperatures, for I believe it is possible that a better method than we used may be developed. I feel, however, that the method used does give reasonably accurate determinations of what is taking place.

Second, with regard to the kind of timber, you will note that there were some Eastern hemlock ties used. We had hoped to use Douglas fir and we had some Douglas fir ties on the ground. We had a great deal of trouble with the thermometer, however. By the time we got it working properly the condition of the Douglas fir ties was such that they could not be used in the experiment.

MR. W. W. LAWSON: Mr. President, the last conclusion, No. 11 in Mr. Hunt's paper, in regard to the checking of material, is very interesting to plant operators. It says: "In the treatments with steam at 20 pounds pressure the green ties were badly checked while seasoned ties were not so seriously affected. In the other treatments none of the ties was seriously checked." Going back to the method of heating, the report reads:

"In the steam treatments the steam was applied at the specified pressure and temperature of the cylinder brought up to its maximum as quickly as possible." This shows how experimental work gets away from the practical, for another conclusion reached is that it takes 30 to 40 minutes for the heat to penetrate to the center of the ties. In practice it takes about 30 minutes to raise the steam pressure in the cylinder to 20 pounds, thus giving the heat time to penetrate to the center of the tie and causing more uniform expansion and, consequently, less checking than when the pressure is applied very quickly. So, in practice, ties steamed with 20 pounds of pressure are not seriously affected as to strength or checking.

MR. WM. W. HILL: Mr. President, I would like to say a word in answer to Mr. Lockett's question about the preliminary vacuum before steaming. Now, at Port Reading, we always draw a preliminary vacuum before steaming ties or steaming anything. Our chief reason for doing this is to get rid of the air in the cylinder and in the ties. If you don't, the pressure in there is the sum of the pressures of the air and steam, and unless you do get rid of that air you cannot make your theoretical temperature correspond to the pressure on the pressure gage. We have not made any tests about the wood heating up any quicker or anything along that line, but I do believe it does do that and certainly there is lots of room for investigation.

MR. EDW. F. PADDOCK: Mr. President, just one other remark in connection with what Mr. Hunt has stated regarding the fall of temperature when the vacuum is applied and referring to his curve, Fig. 4. He spoke of the fall in temperature as being probably due to evaporation, the evaporation of the moisture taking the heat from the wood. Fig. 4 is the red oak tie curve. If this was so then for seasoned ties the temperature should fall off less rapidly than for wet ties, because in wet ties there will be more water to evaporate, and, consequently, more heat would be taken away from the tie, but as a matter of fact in these curves it falls off more rapidly than in the other two. The theory sounds reasonable. I can see no other way to account for it, but these tests seem to contradict it.

THE PRESIDENT: Mr. Hunt, do you care to add anything to this?

MR. GEO. M. HUNT: I would not dare to try to answer that question without making a more thorough study of the particular curve.

THE PRESIDENT: This interior temperature of timber after timber has been subjected to heat is a very interesting one indeed and one that a good many of us have had a very large amount of experience with, I having been present at, I suppose, 10 or 12 of these tests on a rather large scale. We attempted very carefully to arrive at how fast the interior temperature of the timber went up under certain conditions, and so far as I have been able to see we have not succeeded in having the thermometer absolutely reflect the temperature of the fiber of the wood. There has been in all the tests that I have seen carried on a little influence of heat other than through the wood fiber. For that reason it is very interesting, and that is the reason I brought out the point. I am very glad to know that they have succeeded in getting a condition that they think will show the condition of the interior of the timber. That is the reason I wanted Mr. Hunt to make the point strong.

Are there any more remarks on this paper? If not, we extend the thanks of the Association to Mr. Hunt for this work and hope that the investigation will be continued at the laboratory to bring out further

points and some of the other points that have been suggested during the meeting.

We will now call upon Standing Committee No. 5, headed by our friend, Mr. Waterman, and we will ask the Committee to come forward and take their places with us on the platform.

Mr. Waterman then presented the report of the Committee as follows:

REPORT OF COMMITTEE ON MISCELLANEOUS SUBJECTS.

To the Members of the American Wood Preservers' Association:

The Committee on Miscellaneous Subjects has been considering during the past year, "Treatment of Red Oak Ties." It sent out a list of questions to all the members. From the amount of labor required to digest and arrange the replies,, the Committee feels that the ques- could not have been sufficiently clear. Moreover, the number of replies was disappointing. Thirty-three all told were received, nine of which reported "No Experience." An effort has been made to present the answers in such shape as to make them useful.

The measure by which one may judge as to whether the Committee has served its purpose will be the completeness of the discussion. We will, therefore, assume that the desideratum is to invite and, possibly provoke, discussion.

The function of our published "Proceedings," while setting forth what is standard practice, is dual in its nature.

First: They record the experience and theories of the members individually. Sufficient attention in the pages should also be devoted to conclusions and recommendations, on the part of the Association, in order that the members may possess authority for their views on each phase of timber treatment. In this respect the Proceedings serve as a guide. We will possess no other authorized guide until the Association publishes a "Manual" such as is the practice with the American Railway Engineering Association.

Second: It affords customers (of commercial plants) with a reference library to which they may go when seeking general or specific information pertaining to the industry of timber treatment. Such customers, or prospective ones, thereby avoid the necessity of depending upon the judgment or advice of any one treating man, or of any few treating men, with whom they may come in contact. The customer can accordingly avail himself of the composite judgment and experience of the membership of this Association. We have sufficient faith in our chosen occupation to invite the fullest research and investigation of our methods. Moreover we are convinced that the more the customer learns, the more he wants our

product. Hence the desirability of well prepared committee reports, full discussion of the subject matter covered and—above all—that the matter be generalized and conclusions adopted by the Association.

The day is past when the plant superintendent or treating engineer could suspect that effort, on the part of the Association to reduce methods of treatment to standard practice, and publish same, encroaches upon his stock in trade. One of the chief assets of the superintendent or treating engineer, is to pass judgment as to the details of procedure in each treatment wherein specifications afford the necessary leeway or when no specifications govern. This observation applies to the degree of air and hydraulic pressure, temperature, vacuum, et cetra, employed, or their duration. The importance of efficient superintendents and treating engineers is greater today rather than less, as compared with ten years ago. Competition has brought this about. Obviously, however, the Association cannot draw hard and fast rules. No Association can do this.

The contention of this Committee is that timber treatment is a scientific pursuit and, as such, its controlling features can be generalized. The limitations of each of its phases can be reduced to established principles. In this sense the Committee invites free comment and criticism of the matter submitted in this report. It urges careful consideration of each conclusion and the adoption thereof in such modified form as appears best. It urges, moreover, that the members be advised that their experience and views carry far greater weight with those who make use of our Proceedings than they, the members, in their modesty, are aware of. In fact, it must be borne in mind that there is no higher authority, in the science of Wood Preservation, than our Proceedings.

Before submitting the substance of its report, the Committee desires to state that it might have made use of material in some of the replies pertaining to certain of the patented processes, but withheld from so doing. It believes, however, that the discussion will develop the manner in which the conclusions may be applied to each process.

The Committee desires also to express its thanks to those members who replied to its questions and to urge not only upon them, but the others, who did not reply, a full discussion of this report.

Questions Sent Out By Committee and Replies Thereto.

Question No. 1:

Should red oak ties be treated before being air seasoned for one year?

Replies:

Yes, when air seasoned only—8 to 12 months	9	
Yes, if artificial seasoning is also employed	4	13
No—Would not treat	6	
Depends upon the process of treatment	2	
Depends upon weight per cubic foot	2	
Depends upon locality and climatic conditions	1	
No experience	9	20
Total		33

Question No. 2:

Would you consider seasoning for one summer sufficient for treating red oak ties?

Replies:

Yes, when air seasoned only—6 to 8 months	5	
Yes, if artificial seasoning is also employed	7	12
No—Would not treat	7	
Depends upon process of treatment	2	
Depends upon weight per cubic foot	2	
Depends upon locality and climatic conditions	1	
No experience	9	21
Total		33

Question No. 3:

Should red oak ties be treated before they have had one summer of seasoning?

Replies:

Yes, when air seasoned only—4 to 6 months	2	
Yes, if artificial seasoning is also employed	6	8
No—Would not treat	12	
Depends upon process of treatment	1	
Depends upon weight per cubic foot	2	
Depends upon locality and climatic conditions	1	
No experience	9	25
Total		33

Question No. 4:

What method would you employ in treating red oak ties:
(a) If air seasoned one year?
(b) If air seasoned six months, including summer?
(c) If air seasoned one summer?
(d) If air seasoned four months?
(e) If air seasoned two months?

Replies:

Replies to this question, with its sub-heads, have been tabulated as follows:

METHOD OF TREATING RED OAK TIES THAT SHOULD BE EMPLOYED FOR DIFFERENT PERIODS OF SEASONING.

Period of Seasoning.	Air Seasoning Only.	Steam and Vacuum.	Vacuum.	Boil in creosote.	Steam and air seasoning.	Would not treat.	Depends on Progress.	Depends on weight or moisture determination.	Depends on localities and weather.	No experience.	Total.
(a) Seasoned One Year..	18	0	2	1	0	0	2	1	0	9	33
(b) Seasoned Six Months, including Summer..	9	1	2	1	0	6	2	2	1	9	33
(c) Seasoned One Summer	5	3	2	1	1	7	2	2	1	9	33
(d) Seasoned Four Months	2	3	1	1	1	12	1	2	1	9	83
(e) Seasoned Two Months	0	2	0	2	1	19	0	0	0	9	33

Question No. 5:

Are you favorable to treatment of red oak ties by the empty cell process and if so, what injection per cubic foot do you recommend?

Replies:

Yes, injection of from 5 to 10 pounds per cubic foot..	17
No	7
No experience..	9
Total........	33

Question No. 6:

Do you believe in basing your opinion as to whether red oak ties are ready for treatment by making a boring test to determine moisture, or by the weight per cubic foot? This question to be answered in the event the period of seasoning does not govern.

Replies:

Boring	2	
Boring and weight per cubic foot....................	4	
Boring and period of seasoning......................	3	
Weight per cubic foot..............................	2	
Moisture determination.............................	3	
Moisture determination and weight per cubic foot......	2	16
No answer...	8	
No experience.....................................	9	17
Total........		33

Question No. 7:

If boring test is used, what depth or penetration of dryness should govern the decision to treat?

Replies:

Two inches of dry core	6	
1¼ inches to 1½ inches dry core	3	
Dry core throughout	3	12
Moisture 17% to 28%		3
Do not use test	9	
No experience	9	18
Total		33

Question No. 8:

If weight per cubic foot is held to govern, what weight should be used?

Replies:

From 48 pounds to 56 pounds per cubic foot, with average of 52 pounds	9
No answer	15
No experience	9
Total	33

Question No. 9:

Some operators pursue the practice of sawing and splitting red oak ties occasionally to determine penetration of the antiseptic. If this is your practice, kindly state how long after the ties are removed from the cylinder do you wait before employing this method?

Replies:

Replies range from immediately after removal from cylinders to 90 days, with an average of two weeks	24
No experience	9
Total	33

Question No. 10:

Do you believe in steaming red oak ties and thereafter applying vacuum in order to season them? If so, have you had favorable results?

Replies:

Yes	5	
Yes, if air seasoning follows steaming	1	6
No	7	
No answer	11	
No experience	9	27
Total		33

Question No. 11:

If you give full cell treatment, kindly furnish sample retort report indicating hydraulic pressure, with duration of same; also final vacuum for drip, if you employ it. Please also indicate injection per cubic foot.

Replies:

There were but three replies to this question. It is deemed best not to submit same.

Question No. 12:

If you treat by empty cell method, please furnish sample retort report, giving air and hydraulic pressures, with duration and length of same; also final vacuum with duration, if you employ the latter, please also indicate injection per cubic foot.

Replies:

There were but three replies to this question. It is deemed best not to submit same.

Question No. 13:

If you possess any service tests on red oak ties, will you kindly furnish a brief report on same?

Replies:

There were but three replies to this question, only one of which was definite. This reply indicated that 550 treated red oak ties were placed in track in 1900. Sixty-eight of these have been removed on account of decay, and three for laboratory inspection.

The Committee is convinced that many service tests exist which should appear in the record.

CONCLUSION ARRIVED AT FROM REPLIES.

1.—Red oak ties can be treated satisfactorily when air seasoned for ten months, if the summer months are included.

2.—Red oak ties may be treated satisfactorily when air seasoned for six months, provided artificial seasoning is employed as an adjunct.

3.—For practical reasons the period of seasoning, to determine whether red oak ties are ripe for treatment, should govern.

(a) However, if boring test is used, the core withdrawn with an increment borer should appear dry for a depth of two inches.

(b) If weight is used, the weight per cubic foot should not exceed 52 pounds.

(c) If moisture determination is resorted to, a test should indicate not to exceed 22% of moisture in the ties.

4.—Artificial seasoning of red oak ties apparently has not been sufficiently developed to justify a conclusion from the replies.

Committee Conclusions.

The committee is of the opinion that some of the foregoing conclusions, which the replies to their questions indicated could be drawn,

are unsatisfactory. The Committee desires to shoulder the blame therefore, in view of the fact, as previously stated, that the questions sent out were probably not as clear as could have been desired. The Committee, has, therefore, drawn up a list of conclusions, which appears not only to represent the judgment of the members replying to the questions, but more clearly sets forth practice of the Association at large. It is the belief of the Committee that their conclusions, which follow, will draw out discussion in full measure.

1.—Red oak ties should be air seasoned for at least one year before attempting to treat them.

2.—It is practically impossible to season a red oak tie so as to render it dry throughout.

3.—For practical reasons the period of seasoning, to determine whether red oak ties are ripe for treatment, should govern.

4.—Artificial seasoning of red oak ties fails to give the desired result,

5.—Penetration of the heart wood of red oak ties can be secured practically with the same success as in the sap wood.

6.—The use of an increment borer in determining the penetration of an antiseptic treatment in red oak ties fails to give conclusive results. A tie showing insufficient penetration when inspecting the core, which is withdrawn by an increment borer, will in the majority of cases show satisfactory penetration when the tie is sawed and then split. (Those who consider red oak a refractory wood to treat, should try the latter test before reaching a final conclusion, either generally or specifically, when considering the question). The sieve-like character of a cross section of oak offers longitudinal pores or channels from end to end of the tie, through which the antiseptic fluid is forced. The separating medium between the pores may not take much oil and thus appears not to have been penetrated by the oil, when viewed in the core withdrawn by the increment borer. This medium may contain oil, however, and not show it to the naked eye. Even so the pores are well filled and sufficiently so to arrest and prevent decay of the tie.

7.—Red oak ties may be treated satisfactorily with any standard process.

J. H. Waterman, *Chairman.*
M. K. Trumbull,
A. G. MacIntyre.
S. B. Lindley, *Committee.*

THE PRESIDENT: We thank the Committee for this excellent report, and we want a full and free discussion of this subject. Red oak

ties form one of our large products, a great per cent. of the treatable ties, and we would like to have a full discussion.

MR. E. B. FULKS: Mr. President, a few years ago, when this Association was young, only a few of us attended these meetings and when anybody got up to speak we knew who he was and why he was. Since, under the more recent and very popular administration, the membership seems to have increased largely, so that undoubtedly there are now a good many people here who do not know one another, at any rate, there are a lot here that I do not know, I would like to suggest that you ask each speaker on arising to announce clearly and distinctly who he is and what his connection is. That is a good way to get acquainted.

MR. J. H. WATERMAN: You have not attended the meetings here or you would know the President has already made that announcement.

MR. E. B. FULKS: I heard that he did, but I do not hear anybody announcing his name or connection, and that is the reason I made the suggestion.

MR. L. B. MOSES: Mr. President, we treat practically no ties except red oak at our Madison plant. The question of the length of time that the ties should be seasoned came up in a number of instances last year, and so on February 6 last we took eight ties, selected to represent as nearly as possible all the different forms of ties that we get, and very carefully measured and weighed them; then took those same records on the sixth of each month thereafter.

Now, those ties (all of them green right from the stump on February 6) showed without any exception that they reached their low point on August 6, after six months of air-seasoning. Now, on August 6, the low point was reached. In every case the September weight was greater than the August weight. In every case the October weight was almost back to the August weight. In every case the November weight was back to practically the September weight, and December weight was greater in every case than November. Now, while I do not know anything about the scientific way of going after these things, this looks to me like absolute proof that under the climatic and other seasoning conditions at our Madison Plant (of course, this would not hold true in all other places) six months is the limit of time which it is necessary to air-season red oak ties before treatment. Another point is that there was (very much to our surprise) practically no difference in the decrease in weight per month in the spring and summer as compared with the winter and fall months. The decrease was almost uniform throughout the year. Those weighings are being continued on the sixth of each month, and at the next meeting of this Association we will have a very complete record extending over nearly two years. The weight of these eight ties since last February is as follows:

REPORT COVERING TESTS FOR AIR-SEASONING 6″x8″-8′ RED OAK TIES, MADISON, ILL.

February to December, 1914. (In Pounds).

Tie No.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1	200	195	190	182	175	168	163	166	163	165	173
2	195	190	187	178	169	163	157	162	158	162	170
3	166	156	158	150	144	137	133	135	132	135	142
4	172	168	165	156	147	141	136	142	138	140	150
5	176	169	164	155	148	142	137	141	136	140	146
6	184	178	172	162	155	147	143	145	143	145	153
7	149	145	141	133	125	119	114	118	115	116	125
8	155	150	146	137	130	123	118	123	116	122	129

And so, in view of the fact that we know six months to be the full length of time needed for the most thorough air-seasoning red oak ties can get at Madison, we cannot allow the Committee's statement that 12 months would be better, to go into the record without qualification. Twelve months may be better at other places (I happen to know that it is, especially in the South), but six months is better at Madison. The other conclusions of the Committee I think we take no exceptions to. The third one I do not understand. I do not know what it means where it says: "For practical reasons the period of seasoning, to determine whether red oak ties are ripe for treatment, should govern." Apparently there is a typographical error there. I do not get the sense of it.

MR. J. H. WATERMAN: Mr. President, may I ask Mr. Moses a question? Now, to be fair, and I know you want to be fair, you should get eight ties in March and eight in May and eight in June and eight in July and all the year. Then weigh those and when you get through this is what you will find: You will find that the ties cut in the winter months will do just exactly what you say they will, but you will find the ties cut in June and July and August will not reach their low point in six months.

THE PRESIDENT: Mr. Waterman, would you suggest a correction in conclusion No. 3 in order to answer Mr. Moses' question? I think possibly he means that the experiments by treating should govern, that is in each case you should undertake a series of experiments to govern proper treatments. Wherever practicable you should get experience before carrying on experiments to determine whether the material is sufficiently dry to treat.

MR. M. K. TRUMBULL: What was intended in that conclusion is simply this, that despite the fact that we can form our judgment as to whether red oak ties are ready to treat by making moisture determination, by boring or by weight per cubic foot, yet for practical reasons the period of seasoning is what should govern in the long run. I think you yourself expressed this view in your reply, Mr. Rex, and many others did. Some members replied that 50 or 52 pounds per cubic foot is the proper weight, some that 20 or 22 per cent. of moisture content should be reached in the process of seasoning, but that they use the period of seasoning for practical reasons. If the language is obscure we might revise it.

THE PRESIDENT: Does that make it plain, Mr. Moses?

MR. L. B. MOSES: That is all right.

THE PRESIDENT: I would like to call on Mr. Signor to give us his experience in seasoning red oak timber.

MR. GEO. W. SIGNOR: Well, I have had quite a good deal of experience in regard to seasoning red oak ties in the last few years, and Mr. Waterman's suggestion is just what I was going to make myself—that it depends a good deal on the time the ties are cut, and the location. I agree with Mr. Waterman in his suggestion that in testing the amount of moisture in the red oak ties, as Mr. Moses said they did, taking eight ties each month and testing them as to the moisture in them by the weight, they should have taken ties that were cut in each month—and not ties that were all cut in February, or when the sap was out of the wood.

THE PRESIDENT: Does that make it plain, Mr. Moses?

MR. L. B. MOSES: That is all right.

MR. GEO. W. SIGNOR: For instance, in the country around Madison, in that climate you can make red oak ties for two months later than you can down in our Southern coast country, and they will dry out much faster than they will down there, because they do not have the heavy dews that we have during the spring and summer months. These dews are more like showers of rain at night, and the ties absorb more or less of the dampness while seasoning along the line of the railroads, and even in the yards at the plant. We have to season them about 12 months, even the winter-cut ties, and have to tell by the increment auger when they are fit to treat. We cannot tell any other way, because they are cut at all times of the year and stacked up on the right-of-way, most of them in the creek and river bottoms, for that is where the best red oak timber grows and where most of the red oak ties come from. They hold moisture longer while they are stacked along the road in these creek and river bottoms than they do in the hills.

Of course it takes them longer to dry out when they are cut when the sap is up in the timber. If you cut them and put them out in the sun, when the sap is up, they will dry very fast at that time of the year, but they will check badly.

It would take too long to tell about the treatment of the red oak ties. I would like very much if you have any copies of the Committee's report to have one, and I would like to have some time to prepare in order to discuss this further. I have been in the tie business about 45 years and have gotten out about 58,000,000 ties since I have been in the business, and have made timber—the different varieties and the life of it—a lifetime study. I do not know very much about the treating part of it, although I know something about it, as we experimented a year and tried everything and every way we could think of to treat red oak ties without seasoning, and found them all a failure, and it cannot be done by steaming, as you cannot steam a red oak tie successfully; it will check in spite of all you can do.

I want to say just a word or two more about climatic conditions.

Down in the Southern country where I am operating, the latter part of September and October is our dry season, and we find it about the driest time we have. The red oak ties are really drier then than they are in the summer, because we do not have the heavy dews at that time, which makes a great deal of difference.

I have been contracting for ties for a good many years and have never yet made a contract that the railroad company did not receive the ties on the right-of-way stacked in piles, or on the cars, and they always inspect them on the line. They send their inspector out with every contractor to inspect the ties when they are furnished. They are supposed to be taken up every month, and if the railroad company does not furnish equipment to load these ties out and put them in the plant before they decay it is their fault. The ties are theirs then, not mine, and they pay me for the ties when I deliver them.

THE PRESIDENT: We are very glad to have Mr. Signor's discussion because he has been the "old man" in the business and has had a lot of experience in seasoning. I would like to say, Mr. Signor, that these subjects are quite likely to be continued from time to time and any of these points that you think of we would be very glad to have a written discussion on, any points that you are familiar with.

I would like to ask Mr. Paul, who has had large experience in treating red oak in the South for several years and has been associated with a lot of experimental work, express his opinion.

MR. H. A. PAUL: I do not exactly understand what opinion you want. On the treatment of red oak—is that it?

THE PRESIDENT: Yes.

MR. H. A. PAUL: With creosote or zinc?

THE PRESIDENT: The seasoning of red oak.

MR. H. A. PAUL: I am employed by the Rock Island and the Missouri Pacific Railroads as treating inspector at the Ayer & Lord plant at Argenta, Ark., where the seasoning of red oak ties is subject to the Arkansas weather conditions.

As a general rule we season red oak ties for one year, but I have found that ties that are placed in our yard in January, February and March are often well seasoned by the following October. This is dependent, of course, on a large percentage of fair weather during the summer. For other than winter-cut ties I believe a full calendar year's seasoning is necessary to put red oak ties in proper condition for treatment. In the past 12 years I have personally weighed a million ties, more or less, in seasoning and treating tests and about one-half of these weights have been individual ties. In our treatment of year-old ties we find quite often that the ties are not thoroughly seasoned, and we stop treatment and season the ties a few months longer. My experi-

ence has been that the length of time necessary to season any kind of ties is dependent to a great extent upon climatic conditions.

THE PRESIDENT: I am certainly glad to have Mr. Paul's opinion, because Mr. Paul has possibly weighed more ties than any other member of this Association, and his conclusions are valuable. Now, anybody else?

MR. A. C. SCHOLTZ: I have had a great deal of experience in the weighing of ties. I have weighed, I believe, as many ties as anyone here, having charge of the Mt. Vernon plant for eleven years, where up to two years ago we weighed every run made. Most of the members of this Association know the results of the durability of the ties treated at that plant during 1899, 1900, 1901, 1902, 1903 and 1904. The ties were all seasoned from 9 to 11 months, their average weight being 53.5 pounds to the cubic foot. Ties ought to be seasoned at least 9 to 11 months in Illinois territory.

THE PRESIDENT: That is entirely true [referring to previous remarks by Mr. Signor], because the same conditions that Mr. Moses speaks of in increasing weight in October commencing in Madison will not reach us in the South until along early in December. That is an excellent point to bring out. There are two or three other points in this paper that are very interesting if we had time to discuss them, but we will have to pass rapidly over them. I am going to ask Mr. Sterling to say a few words on this Committee report and then bring the Committee report to a conclusion.

MR. E. A. STERLING: Mr. President, having listened to this excellent and interesting report and to the discussions, most of which are pertinent and instructive, I would not attempt to add anything further. I think, however, we have gone far enough and covered the subject thoroughly enough so that I might offer a motion to the effect that this report be accepted by this Association as information, with thanks to the Committee.

MR. F. D. MATTOS: I second the motion.

THE PRESIDENT: It has been moved and seconded that the Association accept the report of the Committee. Are there any remarks on this motion? If not, all those in favor of it will signify it by saying Aye; opposed, No. Carried. The report has been accepted. On behalf of the Association I wish to thank the Committee for their valuable work.

We are going to hold you 35 minutes longer, and we are going to try to cover the reading of two more papers in that time. We will hear now from Mr. Taylor on the Final Inspection of Timber.

MR. C. M. TAYLOR: If any of you do not agree with me save the criticisms until the last, please.

THE FINAL INSPECTION OF TIMBER.

By C. M. Taylor.

Rotten ties are an abomination unto the user for he is laying up trouble for himself. Those who have not tasted of its fruit are either born lucky or have had the good fortune to escape the evil.

There are two ways of escaping the evil and I will try to establish certain precautionary measures. Creosoting has been placed in much the same relation to diseased timber, that radium has in connection with cancer. Creosote costs money and the popular idea has been that it penetrated throughout the entire stick of timber treated and if there were any rotten spots in the stick, that the creosote would hold up its hands in a sort of supernatural power and say to the rot to stop and by the same supernatural power it would stop. The same theory arose with the use of radium, that it had curative powers of a wonderful nature and that its penetrating powers were greater than a 100% coal tar creosote. But it has not done it, nor will creosote or any other preservative cure a tubercular tie, or piling, and the sooner you and I and the other fellow who is the user, realizes this, the sooner we will be able to say to the concrete tie, pile and pole man that he must fight for his life, because treated timber used in modern slow burning construction has come to stay and that concrete just because you cannot take a match and start a fire with it, is a far more dangerous building material than we had ever thought it was. For references see the Edison fire and many other recent concrete fires.

But in the long run it is much better to boost our own product and leave the other fellow knock yours. There is not a member of the Association that cannot give wonderful results in timber preservation, if he has the proper timber.

Before timber preservation came into general use, the consumption of ties consisted mostly of white and rock oak, chestnut, cedar, heart pine, fir, red wood and a few local species. All of our inspectors were familiar with the physical defects of these timbers, and it was wonderful to note that the main point of inspection in connection with these woods, was that of size. Sap rot was tolerated in heart pine and worm holes were excused in oak and chestnut, so that the best inspector was the one that got good sized ties.

We turned to timber preservation and naturally we used the same inspectors because they were timber men and knew their business. But we commenced to use another kind of timber. We decided that we could use any timber that measured tie dimensions, and the inspector still inspected according to dimensions. We commenced to get gum, red oak, sap pine, maples and beech, bigger than we had previously gotten our ties. We were all pleased. But we had entered into a

new timber field. We had started to use a timber that was not able to take care of itself. We had to safeguard it, and the education of timber seasoning has many gravestones strewn along its path, and I am sorry to say that we are still planting these stones. It always takes a streak of lightning to cause an explosion.

I am confident in my own opinion that the greatest failure in timber preservation and likewise the greatest successes are due in the first instance to rotten timber and in the second to sound timber. I believe the grade of oil has less to do with preservation than either the soundness of the timber or the penetration.

The first great lesson that all inspectors must learn in dealing with what I call sap woods which include the commonly used woods for timber preservation, is that you cannot see through a tie and that the surface is the last place timber destroying organisms display themselves. This is especially true of sap pine. To those who have never used this timber let me say that if you can use it green, use it that way, and if you season it do not rely on your inspector to cull out all of the rotten ones, because he will not get all of them. He cannot do it, and everyone he passes is only adding counts against you and the timber preserving process you are using.

If you do not need to bore and adze your ties, you ought by all means to cut off a little from each end of every seasoned pine, gum, oak, beech, or soft maple tie that you treat. It is astounding the number of ties that to the keenest observer appear absolutely sound, yet sawing a half inch off each end of a tie enables you to see clearly and know positively that you have a sound tie. If you don't believe me, go to any timber preserving plant where they use saws, and the whole trouble is that not enough are using them, and see for yourself. If you are not convinced then, for the good of the timber preserving industry you ought to stop treating, because you are only helping to kill the good industry.

In our case we use the cut off saws in connection with our adzing, boring and dating machine so that extra cost of using the cut off saws amounts to very little and the inspection gained thereby gives us results that more than compensate for the cost.

But to the average timber user, this extra precaution may seem superfluous and suggest that the average life of ties or timber is not affected by a few failures. The great trouble with this world of ours is that it is full of human nature of a sort that does not clap its hands as much at a herculean task well done as it does at a failure of a few ties at one dollar each.

It has come to be a common excuse in treated ties to say that a tie, that goes out in a few years, was rotten before it was treated and

we all know that it was rotten. But are we able to say that we will not treat any more rotten ties? I say no, unless we inspect ties with more than a superficial inspection.

That which applies to ties, applies in a relative way to switch timber, piles, poles and bridge timber. Take the case of pine piling that is stored at a treating plant subject to call. Usually it is in long lengths and even when piled with good air spaces between each stick, there is not the same seasoning possible as in short length sticks such as ties and consequently they do not season as well. We have trouble seasoning pine ties and seasoning pine piling in the south is subject to much greater danger of rotting. However, in the majority of cases the same preventative can be used; namely, the cutting off about six inches from each end of the pile, or in case both ends cannot be cut, the butt end should always be, which will give you a very clear indication of the soundness of that pile, and I believe that anyone who stores pine piling for seasoning, no matter in what climate, could well afford this additional expense of inspection.

As for pine timber, there are again only two ways that this should be treated. Either stump green or thoroughly air seasoned, and if you use it green it can be of any inferior grade, commonly called standard which has plenty of sap wood on it. If you season timber, you are taking grave chances if you try to air season anything but merchantable grade, and even then if you do not cut off the ends you are assuming its soundness. Red heart that does not show up in the green state will often appear with the seasoned stick and be properly rejected if it shows unsound condition after the end of the stick is cut off just before it is treated.

In the case of red oak, the inspection in the green does not always clearly indicate pipe rot, but inspection after seasoning and using the cut off saws, always insures the rejection of pipe rot.

There is one question in connection with red oak. There are some who believe that in the case of a large red oak tie that a certain amount of sap rot can be tolerated. To those who believe that way, let them continue on their journey, but to those who are in doubt, remember that treated sap wood is approximately as strong as heartwood. Consequently due to the fact that tamping wears out the ties on the lower side faster than properly tie plated ties wear out on the surface, you can readily see that you do not want any rotten sap wood on any kind of a tie.

The things that I have said in a precautionary way in this paper refer chiefly to pine, but to those users of northern hardwoods in the middle Atlantic and middle Central States where hardwood ties are cut in the winter time and the ground is not covered with snow, there

is a great liability of the same rottenness appearing in beech and soft maples and the cut off saws will again eliminate your troubles. Much as we would like to we have not as yet devised any cut off saws capable of sawing through "S" irons, but it has been my experience that in the great majority of cases any tie that has strength enough in it to start to check on the end, has also the making of a good tie if properly "S" ironed and it is those hardwood ties which do not check that you need to be careful about.

As a final reminder let the timber preservers realize that the following little ditty has much meaning and it is one to be guarded against in doing legitimate business:

A little powder and paint,
Will make things look what ain't.

THE PRESIDENT: One would only have to read this paper to know that Mr. Taylor had long and interesting experience in the South. The troubles which he mentioned are quite familiar to all of us who have been operating in that territory. I hope we will have some rapid and interesting discussions on this subject. The time is limited; let us talk rapidly.

MR. J. H. WATERMAN: Mr. President, I do not want to take up much of your time. I want to compliment Mr. Taylor on the facts he has brought out. Do you not know if you send out a carload of ties and they find one rotten tie they will make more fuss than if they got 10 carloads of the most perfect ties you ever saw? Why, I have been over the road many times and the fellows would say: "They are all rotten." I said: "That is good. Show me." "Well, they are miles away." "How many cars did you get?" "Well, I got three or four cars." "How many rotten ties did you find?" "Well, we found a good many." "But how many? I want to know the number." "Well, I found one." If we find a rotten tie let us refuse to touch it. Do not look at it. Of all things do not treat it.

THE PRESIDENT: Let us have other discussions on this subject. Mr. Lounsbury, have you any remarks to offer?

MR. JAMES A. LOUNSBURY: I do not believe I have.

MR. M. K. TRUMBULL: We would like to hear from men using material that we treat. I see one gentleman here that I am quite sure used some treated material, and I would like to hear from him—Mr. Kent.

MR. A. S. KENT: I do not believe I have anything of interest to say, Mr. Chairman.

THE PRESIDENT: Are there any other consumers in the house who have some remarks to make on this subject? If so, we would like to hear from them.

MR. JOHN FOLEY: At the Pennsylvania Railroad Company's plants we have ruled against the shipment of wood that is at all decayed, and by inspecting each charge as it is loaded we strive to prevent the treatment of such wood. Sawing the ends, as has been described, would be a helpful additional check.

MR. A. C. BECKER: A great portion of the ties are inspected at the loading points and shipped to the plant. They cannot be inspected again there, can they? The producers will not stand two inspections.

MR. J. H. WATERMAN: That is just what Mr. Taylor desires, to have them inspected again.

THE PRESIDENT: The railroad company is usually the one that pays for the ties. They buy the larger number of them at least, and while they may have to pay the contractors or the producers of these ties on an inspection in the woods, I feel sure that they would be justified in throwing them away if, after the necessary seasoning, a second inspection proves that they are pretty much gone from decay. It not alone will eliminate the waste, due to the additional investment of treating rotten ties, but also the additional cost of insertion, hauling and to the unsatisfactory condition of the track due to frequent insertions.

While I do not wish to impose upon you by giving you our practices, I wish to emphatically say that if I had my way we would never again treat a pine tie that had not passed through a boring and adzing machine and had a small section of the end removed to enable us to determine its interior condition; nor would I ever treat another stick of pine piling without having its end cut off for the same purpose.

While we have not yet reached this point for every tie, we are practicing it for every tie that we can put through our machines, and I hope soon to get sufficient machinery to do it for all. I would like to bring a sample or two here tomorrow to show you some of the results of the beautiful yellow pine timber that shows absolutely no signs of decay and six inches in the sapwood is gone.

MR. A. C. BECKER: Whose timber is it? Is that timber in the hands of the railroad company, or is it in the hands of the contractor?

THE PRESIDENT: Well, in our case, and I think in Mr. Taylor's also, the railroad company has its own timber. Of course, we have our own plants where commercial conditions really do not take over the tie until the time it is to be treated. Another feature enters in, and that, I presume, is the question you have in mind.

MR. A. C. BECKER: I was bringing up the question of shipping, from one of the large points on the Ohio River for instance. The railroad company's inspectors take up the ties there and ship them to the plant. They are accepted then by the railroad company. Then I would bring up the question of how the ties would be handled that are thrown out at the plant after they get there.

THE PRESIDENT: Of course, the railroad company in that particular case after the tie was loaded, if you are sure it was sound when you inspected it—

MR. A. C. BECKER: No, it probably was not sound. It was overlooked by the inspector.

THE PRESIDENT: Of course, that is an unfortunate condition of inspection, but I would think that the railroad company would have to stand, in that case, the loss of the tie beyond any question, and I want to say for the Santa Fe that we are more than willing to assume the risk if the ties are sound when we take them and the man has inspected them and they are loaded according to the directions of our inspector.

MR. A. C. BECKER: The question that I brought up before was that I did not know what would become of the material rejected at the plant after it once has been accepted.

MR. JOHN FOLEY: Apparently it is not clear to Mr. Becker that the inspection under discussion is not the initial one by which the ties are graded when they are accepted by the railroad. The second inspection referred to is that given the ties just before they go into the treating cylinder after having been owned and seasoned by the railroad for perhaps a year.

MR. EDW. F. PADDOCK: In regard to the treatment of rotten timber, there seems to be an impression among a great many people, not among any of those present, I am sure, that you can make a rotten piece of wood good by treatment. I recall an instance that recently came up where a sample of wood was sent to our company from Canada for examination. It was spruce and the condition of it reminded me very much of the condition of pecky cypress. The material was 3"x8" and was punctured by holes from an inch to an inch and a half in diameter, filled up with rotten wood that resembled sawdust. The material was unquestionably rotten with these long holes running longitudinally through it, and naturally we refused to have anything to do with the treatment of it, since we did not wish to go on record as recommending the treatment of anything of that kind. If anyone here has had any experience with this kind of spruce in Canada I would like to hear from him as to the nature of the trouble. I am at a loss to

know just what was the matter with the timber, just what kind of rot it was.

THE PRESIDENT: Mr. Signor has been fortunate enough to produce ties on a railroad. Mr. Becker has been unfortunate enough to have to take ties out of the river, and all of us who have taken ties out of a river can appreciate the very great difference. It is desirable beyond any question to accept ties while they still show the green condition, but we, unfortunately, cannot in the case where ties are floated down the river, and Mr. Signor avoids the trouble that Mr. Becker and the rest of us have in certain localities.

MR. H. A. PAUL: The Rock Island has been treating a large number of shortleaf hewn pine ties for the last seven years. During the first three years considerable loss was sustained from various causes, but principally from the receipt of uneven aged ties in the same car and the consequent seasoning of these ties in the same pile. The older ties would develop rot before the newer ties were ready to treat. All of our ties are right-of-way ties, and to remedy the above condition the tie inspectors are furnished dating hammers. Probably 80 per cent. of the pine ties we receive are put on the right-of-way and inspected within 30 days after they are cut from the tree.

Inspection is made every month, and every tie is hammered with the month mark. The tie train loads only ties of the same month's cut in a car and our seasoning yard contains piles of from 500 to 1,000 ties each, all of one month's cut, or such mixture as we allow. We follow the same method with our pine piling and lumber, and, as a result, our loss from rot in handling pine ties, piling and lumber has become almost negligible.

THE PRESIDENT: Is there any further discussion on this subject? If not, a motion to adjourn will be in order.

MR. M. K. TRUMBULL: Mr. President, I move that we adjourn until 10 o'clock tomorrow morning.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: All those in favor of the motion will say Aye; opposed, No. The motion is carried.

An adjournment was then taken to 10 o'clock A. M., January 20.

WEDNESDAY MORNING SESSION.

January 20.

The convention came to order at 10 o'clock A. M.

THE PRESIDENT: We have before us this morning a most inspiring audience, and there are certain facts that come up in this Association, which I cannot resist at this time calling to the attention

of the members. We had yesterday a registration of 110 members and 54 non-members. The largest registration we have ever had previous to this time is 84, and I think without question we are going to exceed our limits on attendance today beyond yesterday, and I would ask that all of you try to be present as nearly on time as possible, as our program is long and we have got to get through. I would like to ask everyone, members and non-members, to kindly register.

Now, another point that adds enthusiasm to the meeting this morning in my estimation is the fact that I hold in my hand the applications of five new members, these coming to us voluntarily, and one of the most pleasant features is that two of these gentlemen are from across the border. Our Association is not an Association of the United States, but it is an Association of America, and I highly appreciate these brothers from across the line for coming down here and associating themselves with us. I hope ere this year is over that we will have a large addition to our membership from Canada. We not only have interested those as members, but we have other attendants from Montreal that came down here to attend this meeting. I think this shows a healthy growth, and that the value of our work is being recognized beyond the confines of our own industry. The membership, as it is growing, includes many new faces and we will not have an opportunity to introduce everybody to everybody else. Can I not ask you to make yourselves known? When you see a strange face ask his name so that you will know each other. By that means we will get closer together.

Our program this morning will begin by presenting the report of Standing Committee No. 1, and we will ask this Committee to come forward and occupy the platform with us. Mr. Ernest Bateman is the chairman of the Committee and will present the report.

MR. ERNEST BATEMAN: The report of the Committee is in your hands, and I do not think it is necessary to read it over. You have it here for your convenience. At a meeting of the Committee yesterday afternoon it was decided that the report should include the definition of "tar" and "creosote oil," which was adopted last year in New Orleans. The definition for "tar" is as follows:

"Tar, in the scientific sense, may be properly defined as the non-aqueous liquid product obtained in the destructive distillation of complex organic matter.

"Tars vary greatly in character, both chemical and physical. They may be roughly divided into three classes:

"Class A. Tars consisting principally of compounds belonging to the aromatic series and containing well-defined amounts of phenoloids.

"Class B. Tars consisting principally of compounds belonging to the aromatic series, but lacking phenoloids.

"Class C. Tars consisting principally of compounds belonging to the aliphatic series.

"Creosote oil, in the scientific sense, may be properly defined as any and all distillate oils boiling between 200° and 400° C. which are obtained by distillation from tars consisting principally of compounds belonging to the aromatic series and containing well-defined amounts of phenoloids."

In the creosoting industry the use of the term "creosote oil" and "creosote" has been largely extended. They have been applied not only to straight distillates from tars containing phenoloids, but also to distillates from the tars lacking phenoloids and to mixtures of all such distillate oils with both crude and refined tars. This looseness in the use of the term "creosote oil" is not of recent origin in the wood-preserving industry. By reference to Lunge, who is a recognized authority on tar products, it will be seen that Bethel, the founder of the creosoting industry, originally used an oil containing substantial amounts of tar. The term is still commonly used to describe oil of such widely varying composition and origin that a more specific nomenclature is at this time highly desirable.

REPORT OF COMMITTEE ON PRESERVATIVES.

To the Members of the American Wood Preservers' Association;

The instructions to the Committee were as follows: To co-operate with similar committees of other associations in the preparation of a standard and uniform specification for creosote; to review and present for the Manual all specifications for preservatives which have been approved by this Association, and third to collect specifications for creosote oil.

The membership of this Committee is such that it contains members of similar committees of the American Railway Engineering Association and the American Society for Testing Materials. This, we believe, insures us of co-operation.

Your committee was unable to find any record of the adoption of any specification for preservatives. References have been made of the specifications of other associations as being safe ones to use or they have been accepted as information by the Association, but there is no record of their formal adoption. The Association has, however, adopted as standard a method of analysis for zinc chloride and a thermometer for use in creosote oil distillations. These are given below.

Method of Analysis for Zinc Chloride Adopted 1912.

Insoluble (Basic Chloride of Zinc).

10 to 14 grams of sample (fused or granulated) or an equivalent quantity of solution are weighed from stoppered bottles into a 600 cc. Jena beaker, 400 cc. of cold water are added and stirred until the material is completely in solution. The basic chloride of zinc is allowed to settle over night. Solution is filtered through a weighed filter paper (12 1-2 cm.). Filtrate is received in a graduated calibrated measuring flask, capacity 1000 cc. The beaker is policemanned, and the insoluble matter is dried over night in a bath heated to 212° F, cooled

and weighed in between clipped watch glasses. Increase in weight is calculated to insoluble (basic) matter. (Note: The filter paper should be previously washed and dried before weighing in order that it may have the same treatment before weighing as it does in the actual analysis. Owing to the fact, that the hydrated oxy-chloride of zinc is slightly soluble in water, it becomes necessary to make the method imperical, and in order to get concordant results between various operators it is necessary to pass all the water to make up the litre through the filter paper upon which the precipitate is retained.)

Estimation of Zinc.

The filtrate from the insoluble matter referred to previously is made up to the mark and shaken. Three aliquot portions of 100 cc. each are taken with a 100 cc. pipette, which has been accurately calibrated volumetrically to the flask used for receiving the filtrate. To each of the aliquot portions in beakers, 15 grams of ammonium chloride are added and 5 cc. of strong hydrochloric acid, and diluted to a volume of 350 cc. with hot water. This is allowed to stand on the steam plate until nearly boiling (180° F.) and then titrated with slow addition and vigorous stirring with standard potassium ferrocyanide solution, using uranium acetate as an external indicator.

This method is not for use where the manganese chloride content exceeds 3-10 of 1%. In such cases the method is varied as follows: to the 100 cc. aliquot portions 1 cc. of hydrogen peroxide (2½ to 3%), and 10 cc. of 1 to 1 ammonia are added. Allow this to stand on the steam bath until settled. Filter off the manganese, wash beaker and paper twice with hot wash water. Dissolve precipitate in the smallest amount of 1 to 1 hydrochloric acid in the original beaker and heat until all dissolved, the volume of the solution should then be about 20 cc. Reprecipitate the manganese with 1 cc. hydrogen peroxide and 10 cc. ammonia, boil, filter and wash several times with hot water. Add filtrate to the filtrate obtained from the first separation. To the combined filtrates add 15 cc. hydrocloric acid and just neutralize with concentrated ammonia, then add 5 cc. hydrochloric acid in excess. Add 25 cc. saturated hydrogen sulphide water to remove any traces of hydrogen peroxide, dilute to 325 cc., heat to 180° F. and titrate as in the previous case.

Estimation of Iron and Aluminum.

10 grams of sample are weighed into a beaker and dissolved in 100 cc. of water. Dilute hydrochloric acid is added in sufficient quantities to dissolve all of the basic zinc chloride. Add bromine water in slight excess and boil off excess. Weak solution of sodium carbonate is added until a slight permanent precipitate of zinc carbonate is obtained. Add three drops of glacial acetic acid and 2 grams of sodium

beakers with hot 1 to 1 hydrochloric acid. Reprecipitate iron and acetate and boil. Filter and wash. Redissolve precipitate in original alumina with slight excess of ammonia, filter, wash free from chloride. Ignite in platinum crucibles, and weigh as Fe_2O_3 and Al O_3.

Solutions Used in Determination of Zinc.

Standard Ferrocyanide Solution: Weigh out 43.25 grams of c. p. potassium ferrocyanide and 14 grams of c. p. crystallized sodium sulphite, dissolve in water and make up to 1000 cc. at room temperature. Shape thoroughly. Keep solution in dark bottles. Standardize against zinc solution of known concentration prepared from spelter of known zinc content or from c. p. zinc oxide previously ignited. One cubic centimeter of this solution will be equal to approximately .01 gram of zinc.

Indicator: Dissolve 4.4 grams of c. p. uranium acetate (free from sodium) in 100 cc. of hot water and add 2 cc. glacial acetic acid.

Wash Water: In all zinc analyses it will be found sufficient to wash with hot water containing 10 grams of ammonium chloride and 10 cc. of concentrated ammonia to the liter.

Hydrogen Peroxide: This reagent is very perishable. It can be tested as to its strength by titrating with potassium permanganate.

Hydrogen Sulphide Solution: The usual saturated solution commonly used in the laboratory is used.

Specifications for Standard Thermometer.

The thermometer shall be of glass, well annealed, and shall undergo no serious change at the zero point when heated up to 400° C. The space above the mercury column shall be filled with gas—either carbon dioxide or nitrogen—and the thermometer shall have an expansion chamber at the top.

The scale shall read from 0 to 400° C. in 1° C. graduations, which shall be etched on the stem.

The tip of the thermometer shall carry a ring for the purpose of attaching tags. The thermometer shall have the following dimensions:

Total length, 375 mm.; tolerance, 10 mm.
Bulb length, 14 mm.; tolerance, 1 mm.
Distance from 0 to bottom of bulb, 30 mm.; tolerance, 4 mm.
Scale length from 0 to 400° C., 295 mm.; tolerance, 5 mm.
Diameter of stem, 7 mm.; tolerance, 1 mm.
Diameter of bulb, 6 mm.; tolerance, 1 mm.

When standardized the accuracy of such standardization should be as follows:

Up to 200° C. to the nearest .5° C.
200 to 300° C. to the nearest 1.0° C.
300 to 360° C. to the nearest 1.5° C.

The Committee has collected a number of creosote specifications, but the list cannot be said to be complete.

Definition of Tar and Creosote Oil.

Tar, in the scientific sense, may be properly defined as the non-aqueous liquid product obtained in the destructive distillation of complex organic matter.

Tars vary greatly in character, both chemical and physical. They may be roughly divided into three classes:

Class A.—Tars consisting principally of compounds belonging to the aromatic series and containing well-defined amounts of phenoloids.

Class B.—Tars consisting principally of compounds belonging to the aromatic series, but lacking phenoloids.

Class C.—Tars consisting principally of compounds belonging to the aliphatic series.

Creosote oil, in the scientific sense, may be properly defined as any and all distillate oils boiling between 200° and 400° C. which are obtained by distillation from tars consisting principally of compounds belonging to the aromatic series and containing well-defined amounts of phenoloids.

ERNEST BATEMAN, *Chairman.*

S. R. CHURCH, E. B. FULKS,
W. H. FULWEILER, C. M. TAYLOR,
L. C. DREFAHL, A. L. KAMMERER,
A. E. HAGEBOECK, O. C. STEINMAYER,
Committee.

THE PRESIDENT: Gentlemen, you have heard the report of the Committee. You have the written discussions. You have the original remarks of the Committee, and you have heard Mr. Bateman's comments. Now, we would like to have a full discussion of this report. This is one of the most important subjects we have before us.

MR. ERNEST BATEMAN: Mr. Chairman, I move the adoption of the report.

MR. O. C. STEINMAYER: I second the motion.

THE PRESIDENT: It has been moved and seconded that we adopt this Committee's report. This is a very important subject, and I would like to hear an expression from some of our men on this report before we adopt it, because we are going to put this in the Manual.

MR. W. W. LAWSON: Mr. President, the analysis of chloride of zinc depends upon the care with which the samples are taken, and I want to suggest that we include in this report specific instructions for

taking samples. We have to exercise a great deal of care in taking samples or they are worthless, and I think it is very important to have a standard method of taking samples.

MR. C. M. TAYLOR: I think Mr. Lawson's remarks are perfectly in order. However, there have been no definite rules laid down for just how you shall take that sample. I have had quite a little experience myself in that line, and I find that the sampling is a very important matter, much as it is in taking samples of creosote oil. However, the duty of this Committee at the present time was not to produce any new specifications, but to review and present for the Manual all specifications for preservation which have been approved by the Association. It is not within our province either to present any new specifications as to method of sampling. It is only to review for the Association the specifications that have been approved for the proposed Manual. I think it might be well to have the question of sampling zinc chloride taken up by a future Committee, but I do not think that was within our province this year.

THE PRESIDENT: Are there any further remarks on this Committee report? You all understand that this is in the early years of our work. We have only had two years of our standing committee work and our committees are trying to collect the essentials for the starting of our Manual. That is the way this Committee report came to be presented in its present form. We would like to have a full discussion on this subject if any of you care to discuss it.

MR. WM. A. FISHER: Are the remarks of the Chairman that were made intended to be included in the report, or are we taking action just now on the printed part?

THE PRESIDENT: The only addition to our Committee report as printed is the definition of "creosote" and of "coal tar." The definition of creosote was passed upon last year at New Orleans and did not get in the printed discussion. All the Committee wishes to include in the Manual, in addition to our printed discussion, are those two definitions. Have you any objection to that, Mr. Fisher?

MR. WM. A. FISHER: None whatever, Mr. President, except that if we are going to adopt those definitions it seems to me it would have been better to have them in printed form, or at least have them read again.

MR. ERNEST BATEMAN: They are in the Proceedings for 1913 and 1914.

MR. WM. A. FISHER: In just the shape in which you wish to include them in this report?

MR. ERNEST BATEMAN: With one exception, that the word "straight" before "distillates" has been dropped for the reason that

there seems to be some difficulty in the use of that word "straight." It did not seem to add anything to the specifications. It now says "any and all distillates."

THE PRESIDENT: Is that a satisfactory explanation, Mr. Fisher?

MR. WM. A. FISHER: Entirely.

THE PRESIDENT: Are there any more remarks? If not, we will put the question.

MR. M. K. TRUMBULL: Mr. President, I would like to ask a question before we get off the question of preservatives. It has no bearing on the Committee report. If I may be permitted to ask the question after the report is disposed of I will be glad to do so.

THE PRESIDENT: All in favor of adopting the Committee's report as printed and the two definitions passed upon by the Association in the 1913 Proceedings, the definitions of "coal tar" and "creosote," with the single exception of the elimination of the word "straight," signify it by saying Aye. Contrary, No. The report is adopted, and we thank the Committee for the report this year.

MR. M. K. TRUMBULL: Mr. President, it appears to me that it would be of great value as information to the members of the Association if some one who is posted would give us some idea of what steps are being taken to increase the domestic supply of creosote. If there is some one in the room, and surely there is, who can give that information, it would be appreciated.

THE PRESIDENT: That is an excellent point and of very great interest to all of us, I am sure, and I believe that we could well spend a few minutes in hearing from both Mr. Fulks and Mr. Church on this subject. I hope they will give us a full discussion. The question, Mr. Fulks, is to give us as nearly as possible what steps are being taken to increase the output of creosote in this country. Both of you gentlemen are thoroughly interested in this subject and are familiar with it, and I know that you can give us a few words that will be of interest to all of us.

MR. E. B. FULKS: I do not know, but I take it that this question relates to the European war situation. That is what we hear most about. Now, in regard to the shortage of creosote, the whole question to my mind is largely one of hysteria. Of course, there has been for the past three months a shortage of creosote in the United States, but when you analyze the situation there is nothing about it to cause alarm.

The situation, as I see it, is approximately this: When war was declared in Europe there was immediately an embargo placed on the shipment of creosote oil from the countries involved. The creosote oil that is used in the United States is approximately 100,000,000 gallons

a year, of which about 60 per cent. is imported. Of this imported quantity approximately 25 per cent. comes from Germany, the balance from other European countries, principally England. That is, about 15 per cent. of the total imported comes from Germany. Now, the embargo on shipments from Germany still exists and will so long as the war continues. It is a matter of necessity for them; they need the oil in their country for fuel. Within three weeks after the embargo had been placed in England it was raised and it is still raised, and as far as I know will stay raised. I hear nothing from our connections over there to indicate that it will be placed back, and there is no good reason for its being placed back. So far as the shortage of imported oil is concerned it really affects only about 15 per cent. of the total used in America. Now, during the five months that the war has been going on, there have been to my knowledge seven cargoes imported and possibly eight, I am not sure. This is less than half or is about a third of the normal importation, but the stock of oil in England is as large as ever. The oil is over there. The shortage in importation is not on account of the shortage of oil in England, but it is on account of the shortage in transportation facilities. The tank steamers and oil-carrying boats are almost entirely sailing under the British flag, and were before the war. There were a few German boats, but nearly all the boats sailed under the British flag, even though carrying German oil. A great number of those vessels were immediately commandeered by the Admiralty for use in the war for carrying fuel to their naval vessels and so on, and are still in that service. Some of them have been sunk. One of them I know that plied between this country and England has been sunk, and there are perhaps others, so really that is the reason for the shortage, but that is being straightened out. Of course, you know there is a movement to transfer boats to American register, but even aside from that, in regard to English boats, there is a movement to get the transportation back to normal, which will be consummated shortly, I think, and so far as the foreign importations are concerned, within a very few months they will be normal, with the exception of the 15 per cent. from Germany, which will continue to exist as a shortage. To offset that shortage there has been a very large increase in the output of domestic oil. There are new plants being built by the company I am connected with and perhaps by other companies, and all are increasing their output, so that the increased output will, at any rate, offset the shortage caused by the German embargo. If we stop and think about this thing a little, see where we stand, and everybody quit going around talking about shortage of oil and "what we are going to do," I think that the business will be found to be in pretty good shape, and that things will go on all right.

THE PRESIDENT: That is certainly an encouraging talk. I would like to ask Mr. Fulks one thing further, as his company is one of the large producers. I want to ask Mr. Church the same thing later on. Would it be proper for you to tell us something about the amount that your company is producing annually, or expects to produce this coming year, 1915, or would you care to state?

MR. E. B. FULKS: It would be proper enough, but I would have to figure a little bit.

THE PRESIDENT: All right. We will ask Mr. Church to make some remarks along this line for the benefit of the Association, if he will.

MR. S. R. CHURCH: I am unable at present to make a fair estimate of the domestic production of creosote oil for 1915. I can say that the production of the company that I represent is not likely to be decreased. While Mr. Fulks has covered the ground pretty thoroughly with regard to the European creosote oil situation, there are one or two additional thoughts that occur to me. You all know that creosote oil is a byproduct from the distillation of coal tar, so that, primarily, the amount of creosote oil that can be produced in the country depends on the production of tar and a market for the residual pitch. Additional tar refineries mean more creosote only if the actual production of tar is increased. Byproduct coke ovens are now the largest tar producers in the country, and we are, therefore, hoping that the steel companies will have a large increase in orders, so that in this way the production of coal tar will be increased. I would also urge the spirit of co-operation between the producers and users of creosote oil, with reference to technical specifications. Without sacrificing the quality of creosote oil in any way, the consumers can often help matters by not being too insistent on unnecessary or complex requirements.

As a market for coal-tar pitch is a necessary feature in the production of creosote oil, I may, perhaps, be pardoned for suggesting that all who are interested in obtaining creosote oil at a reasonable price can help the situation by promoting the use of coal-tar pitch for various purposes.

THE PRESIDENT: Is there any other large producer of creosote oil who would like to say a word at this time? It is certainly encouraging to hear that our creosote market is in a much less strenuous state than we had anticipated. Unfortunately, some of us have had to use the most of our supply, and it has, naturally, made us a little bit nervous about the supply of creosote in carrying on the industry as it is today, because of the annual increase that should legitimately come to us. If the consuming public in general could appreciate the value of conservation as represented by the timber preserving industry, our products or our output would double and treble by leaps

and bounds, and while I had no fear in my own mind of the lack of creosote to carry on our industry as it is at present, the thing I feared was the general opinion that might be created at this time when we are just learning to recognize the value of timber preservation.

MR. M. K. TRUMBULL: Mr. Church referred to the matter of specifications. If any member of the American Railway Engineering Committee on Wood Preservation is present, and could discreetly advise us, we would like to know whether the A. R. E. A. is discussing any modification in the specifications.

MR. S. N. WILLIAMS: I think, Mr. President, that we have not gone that far with our report for the year.

THE PRESIDENT: We have with us the chairman of this Committee of the American Railway Engineering Association, Mr. Stimson. Mr. Stimson, would you care to say a word at this point?

MR. EARL STIMSON: That is on the question of specifications?

THE PRESIDENT: Mr. Trumbull's question was whether the Committee of the American Railway Engineering Association contemplated any changes in the present specifications.

MR. EARL STIMSON: We contemplate no change in the present specifications. We are considering presenting a specification for a mixture of coal tar and creosote at the meeting this March.

THE PRESIDENT: Does that answer your question, Mr. Trumbull?

MR. M. K. TRUMBULL: Partially. I noticed in the supplement to the A. R. E. A. Manual a foot note that indicates that the basis for that mixture had been adopted by the Association. I did not recollect that any action had been taken by the Association which would justify that foot note.

MR. EARL STIMSON: In getting up the Supplement to the Manual of the American Railway Engineering Association there was an error made by the editor. He mistook the precautions to be observed in using the coal-tar creosote, which were offered by the Committee at the meeting last March as information and a guide, as having been adopted by the Association as recommended practice. It was the first precaution only that was adopted as recommended practice, the others being accepted as information.

MR. M. K. TRUMBULL: I was surprised when I saw that foot note, because adopting such measures by the American Railway Engineering Association is of vital consequence to many commercial plants. In other words, if the chief engineer of a railroad, who is a customer of a treating concern, has the authority of the American

Railway Engineering Association to back him up, it goes a long way with him in saying whether he will permit this or that to be done. I was very anxious to have that point covered and that it is aimed to have this question decided at the forthcoming convention of the American Railway Engineering Association.

THE PRESIDENT: I think that the point is very well covered in the report, and I believe when we have our convention in March we will find that the point is thoroughly covered.

We will deviate slightly from the program on account of Committee No. 2 not being quite ready, and we will hear Mr. Horrocks' paper, entitled "A Voice from the Pacific Coast." Before we read this paper I want again to say that since I have been in the Association this is the first time we have had a good representation from our Pacific Coast where a large percentage of timber is being treated, and we are certainly delighted to note the interest and to have these gentlemen come with us with contributions and be present at this meeting. Unfortunately, Mr. Horrocks is not present, but he is represented by his superintendent, Mr. Cobean. We have with us our old friend and charter member of the Association, Mr. Beal, and Mr. Goss, of the Pacific Coast, so we want to thank them and hope this relation will grow closer. Mr. Angier will now read Mr. Horrocks' paper.

A VOICE FROM THE PACIFIC COAST.

By H. E. Horrocks.

Out West beyond the sage brush, beyond the Rocky Mountain barrier, in fact at the extreme ends of our great transcontinental railway systems, you will find, if you take the trouble, the best climate in the world, the greatest area and quantity of the best all around commercial timber in the United States, if not in any part of the world; you will find trees growing to an unprecedented size and degree of perfection; then if you will look and inquire around a little you will find here and there among all these natural advantages a humble representative of the wood preserving fraternity doing his best for the cause of true conservation, fighting the battle against prejudice and indifference, supplying the material with which all of the splendid Pacific Coast ports are being developed, and trying his "derndest" to convince his fellow-citizen that he can pave his streets with a "Silent-Everlasting" material, Creosoted Douglas Fir Wood Blocks.

If you will take the trouble to look for these things, you will also find in charge of the industry on the Pacific Coast, earnest, energetic men who will do their utmost to convert the trouble into pleasure for you.

I have used the word "if" in a hopeful and anticipatory sense; for, as a matter of fact, you Eastern people have not taken the trouble (or pleasure) of finding the Pacific Coast and the Wood Preservers who live there and you don't know what you are missing.

There are on the Pacific Coast seven commercial creosoting plants with a capacity of 85,000 cubic feet and four plants owned by railroads with a capacity of 39,000 cubic feet.

The commercial plants date from as far back as 1895 and at least one of the railroad plants from before that date. Since the industry first obtained a foothold on the Pacific Coast the operators have been making consistent and intelligent forward efforts in the art of timber preservation. The Southern Pacific Railway Company at first operated its plant at Oakland by the steam-vacuum method. Its experience with Douglas fir treated by that process was so unsatisfactory that efforts at improvements resulted in the "boiling process" brought out by Mr. John D. Isaac. This method of treatment is almost synonymous with the creosoting of Douglas fir, only one plant on the Pacific Coast now using the steam-vacuum process. The Rueping process has also been adapted successfully to the treatment of Douglas fir ties, and so it goes, no standing still, but a continual effort at better and more effective methods.

We handle in Douglas fir a timber from which a more diversified product can be obtained than from any other structural timber in the world. We can give you timbers of any workable size. The limit is fixed by structural requirements, not by the size of the tree. Piling 125 feet long are readily obtainable, in fact one company in our country has recently completed a contract for several thousand piles that averaged close to eighty-five feet in length. Douglas fir is an excellent timber for wood block pavement and the virtues of that pavement are now being brought home to our Western cities. Douglas fir is made into cross arms, wood duct for underground telegraph and telephone work, wood stave pipe, etc. In all of these forms Douglas fir is satisfactorily creosoted on a commercial scale, by methods developed by the hard knocks of practical experience interpreted and directed by the common sense, straight thinking of the Western wood preserver.

We appreciate and properly value the results obtained from theoretical and practical laboratory research and exprimental work, in fact the Associated Pacific Coast Creosoting Companies have in their employ an Engineer who had advanced to a position of great responsibility in the Forestry Department, but when we are told, as in Department of Agriculture Bulletin No. 101, entitled "Relative Resistance of Various Conifers to Injection with Creosote," that Douglas fir is not suitable for creosote treatment, we feel like the man whose lawyer told him he could not be put in jail. That party was in jail for all the valuable

advice, and we Pacific Coast creosoters are now successfully treating Douglas fir, have been doing it for more than twenty years past, and we or our successors expect to do it until our forests are exhausted.

We do not believe that the experimental work on which this bulletin is based was sufficiently exhaustive nor carried out in such a manner as to justify the conclusions arrived at or the wide publicity given the comparisons made. If this bulletin is to be accepted as of any value to the industry or the user of creosoted material the only possible logical conclusion to be reached from reading same would be that Douglas fir should not be used for that purpose. Such a conclusion, however, would be contrary to actual experience and to the commercial experience of the timber treating industry on the Pacific Coast. We have here a conflict, theory and previous and present practice at opposite extremes of an argument. We contend that practice has the best of the argument and that theory in this instance at least should have looked better to its facts and should have endeavored to reconcile itself with actual experience before stepping before the world with a brand new idea. We believe the conclusions arrived at in that bulletin so far as Douglas fir is concerned are hasty and the recommendations not justified, and we believe the American Wood Preservers' Association should discourage purely theoretical data of this nature. We believe also that the Forestry Department should make it a practice to compare notes with its Western representatives before publishing conclusions concerning a material with which the experimenters are not, in the nature of things, entirely familiar.

We Westerners believe that all of the efforts of our Association should be directed toward information and conclusions that are of practical value to the manufacturers and users of treated material.

We want you gentlemen to become more familiar with Douglas fir timber and its many virtues and uses; we want you to know us better, and we want to assure you that we will endeavor to make any of you welcome and well pleased with a visit to our Pacific Coast country and the rather scattered population of wood preservers to be found there.

THE PRESIDENT: It has been my pleasure in the course of the last few years to have a great many occasions to visit these wood-preservers of the West and work with them in the treatment of our timber, and I assure you that it is as Mr. Horrocks says, and I hope that more of you will get the opportunity to visit these Western plants and see what they are doing. For the sake of getting acquainted with our Western friend, I am going to ask Mr. Goss to stand up for a few moments and then Mr. Beal and Mr. Cobean to say a few words on this subject simply for the members of the Association to know them and

know their faces so that they will talk to them and get acquainted with this large part of our industry.

MR. O. P. M. GOSS: Mr. President and gentlemen: I did not expect to be called upon for any remarks at this meeting. The one thing which I will say, however, is that we are plugging along just as hard as we can, working in a systematic way, to improve methods of treating Douglas fir. Douglas fir is a hard wood to treat. It can be well creosoted, however, and we are making advances in that direction. While it is not time to say anything about it until we get our process perfected, still we have had more encouragement recently in this direction than at any time in a good many years. I have every reason to believe that within the next few months we will be creosoting Douglas fir, a wood which you all understand suffers from 20 to 40 per cent. loss of strength in treatment, and will be treating that wood without any appreciable sacrifice in strength. You may think this is a pretty strong statement, and it is as much as I am going to say now, but we will be able to deliver the goods just a little later on.

THE PRESIDENT: Mr. Cobean, have you a word to say?

MR. C. E. COBEAN: Mr. President, I have been on the Pacific Coast trying to treat Douglas fir by the boiling process for the past eight years, and I can say that my experience with that class of timber is that it can be treated and is being treated and is being used all over the Pacific Coast for different purposes. I do not think it is fair to the timber industry of the Pacific Coast to have the best timber, the highest grade timber in this country, condemned because a few of the experiments that have been made have not proved satisfactory. I thank you.

THE PRESIDENT: Mr. Mattos.

MR. F. D. MATTOS: Mr. President, I think that Mr. Horrocks has rather drawn the wrong conclusion in regard to Bulletin No. 101. I have carefully read that Bulletin, and it mainly points out that of all the conifers of the Pacific Coast that we have to contend with Douglas fir is the most refractory.

THE PRESIDENT: May we have any other contributions on this subject?

MR. EDW. F. PADDOCK: My experience with Douglas fir is practically nil, but I want to say that as far as the difficulty of treating Douglas fir is concerned I know that for a good many years Portland has been treating it successfully by the open tank and low-pressure methods, so that there ought not to be any great difficulty when using pressure. I know that they have been successful out there with it on paving blocks and structural timbers. If confirmatory information is desired on the subject I can only refer to the City Engineers at

Portland and Seattle, whom I am sure can give you specific and definite information.

MR. F. D. MATTOS: Mr. President, the success of treating Douglas fir by the open tank method depends entirely upon the percentage of sap. If it is all heart you get no penetration to speak of, the penetration in the case of heartwood being merely a surface one.

MR. J. H. WATERMAN: Mr. President, I do not want to discuss this question, but Bulletin No. 101 has been referred to. Who has the Bulletin? Let us see where it says Douglas fir cannot be treated. I notice in Mr. Horrocks' paper he does not put that in quotations. It seems to be his own language, and there are members of the Forestry Bureau here. I would like to have that quotation read verbatim and let us see what it says.

MR. HOWARD F. WEISS: Mr. President and gentlemen: I did not come here with the intention of addressing you, but I believe Mr. Horrocks' paper necessitates a reply from me as the responsible head of the organization at Madison, and, consequently, I want to consider it very carefully with you. Perhaps I can best explain my attitude by telling you a story. There were two gentlemen sitting in a chair car coming to Chicago and they were discussing "conservation"—conservation of natural resources—rather a favorite topic these days. They spoke about the enormous waste taking place in this country, how we were leaving 60 per cent. of the coal in the mines and 70 per cent. of the wood in the forests. Right opposite these two gentlemen there happened to be sitting an elderly lady who was rather stout, in fact, you might say she was "fat," and when this learned gentleman said, "Think of it, only 30 per cent. of the standing trees finds use in the market," the other gentleman, to whom he was talking, happened to be looking at this stout lady and he replied: "My, my, what a waste, what a waste." (Laughter.) She ruffled and said, "Sir, how dare you." Then he had to go and explain that he was not alluding to her girth at all, but was alluding to forest destruction and waste of natural resources in general. Now, I think Mr. Horrocks misunderstands our Bulletin No. 101, and I want to "explain" our position. I have gone over this bulletin and have spent a good deal of time on it because this attack on it furnishes one instance where our researches have not been, I think, taken in the light in which they are intended.

The two points raised by Mr. Horrocks that particularly impressed me are as follows: He says about Douglas fir:

> "When we are told, as in Department of Agriculture Bulletin 101, entitled 'Relative Resistance of Various Conifers to Injection with Creosote,' that Douglas fir is not suitable for creosote treatment, we feel like the man whose lawyer told him he could not be put in jail."

I want to call your attention particularly to this sentence, because I think it expresses the meat of Mr. Horrocks' criticism. Again he says:

"If this bulletin is to be accepted as of any value to the industry or the user of creosoted material the only possible logical conclusion to be reached from reading same would be that Douglas fir should not be used for that purpose."

Now, as I understand it, these are the bases of the condemnation. Bulletin No. 101, on page 14, says:

"Species in Classes 1 and 2 are not very suitable for preservative treatment."

In Class 2 it mentions Douglas fir timber. It is true that that statement taken alone is too strong. Now, at the bottom of page 14 it says:

"In actual treating operations the amount and location of the sapwood will determine in which class a given timber shall be placed."

In other words, taking the classifications given in the latter part of the Bulletin without considering the per cent. of sapwood in timber is something which specifically should not be done. But let us take Mr. Horrocks' statement that "the only possible logical conclusion to be taken from this bulletin is that Douglas fir should not be treated." How can we adjust that statement with the following statements in the publication? Under a discussion of "Round Timbers," Bulletin No. 101 says:

"Results obtained in these experiments and the experience of the Forest Service generally indicate that the following species may be successfully treated in round form: Engelmann spruce, Douglas fir, tamarack, Western larch and all of the pines."

Does this statement warrant the statement made by Mr. Horrocks that "the only possible logical conclusion" to be taken from this bulletin is that we maintain Douglas fir should not be treated? If you turn to the next page of this bulletin, page 16, it says under "Paving Blocks":

"These experiments indicate that, with the possible exception of Alpine fir and the heartwood of tamarack, a fairly thorough penetration of conifers in any form less than 12 inches in length can usually be obtained."

Now, I do not think that statement condemns the Douglas fir paving block or states that it should not be treated. Neither does the sentence on "round timbers," already quoted, which refers to pilings. poles and similar products, say Douglas fir cannot be satisfactorily treated. In my opinion, the only sentence to which exception can be taken is the one in which the bulletin states in regard to dimension timbers:

"Species in Class 2 are also unsuitable for this purpose, but may be treated under very severe pressure."

I will discuss this in a few moments. Again, if one will read the conclusions in the bulletin (and it is our general policy in writing bulle-

tins of this kind to have the conclusions contain the essential points which we wish to bring out), he will find nothing is said about Douglas fir not being suitable for treatment. This publication was intended solely to show that certain structural characteristics of the wood affect the manner in which the different woods take treatment. The publication was not intended to show a classification for commercially grouping woods for treatment. However, I appreciate fully that it is easy to give a wrong impression. An author is likely to give an inference which he did not intend to give. Consequently, in order to remove any erroneous inference in regard to Bulletin No. 101, I am asking that in the copies which are sent out in the future the following insert be made. That the sentence which now reads.

> "Species in Classes 1 and 2 are not very suitable for preservative treatment."

should be changed to read

> "Species in Classes 1 and 2 were most resistant to penetration with creosote."

On Page 14, fifth paragraph, I am asking that the sentence which now reads

> "Species in Class 3 are not very suitable for treatment except in short lengths on account of the lack of radial penetration."

should be changed to read

> "Species in Class 3 were treated with greater difficulty than those in Class 4 on account of the lack of radial penetration."

On Page 15, under "Dimension Timbers," I have asked that the sentence there be changed to read as follows:

> "Species in Class 3, while resistant to penetration, with creosote lend themselves more readily to treatment than those in Classes 1 and 2."

Now, on Page 18, under conclusions, we have said absolutely nothing about the commercial grouping of timbers for treatment, or that Douglas fir should not be given a preservative treatment. While there is no such statement in the bulletin, I have asked that the following conclusion be inserted in order to remove even the semblance of additional misunderstanding:

> "The classifications referred to in this bulletin pertain solely to the effect of the structural characteristics of the wood tested upon their absorption and penetration with creosote and are only intended to aid in the commercial grouping of such woods for treatment."

I believe if this sentence is inserted there will not be any chance for further misunderstanding the purpose of the publication. I hope that this analysis of the publication will clarify in your own minds some of the points I wanted to mention to you.

While I am on this subject I want to bring up a matter about which I feel very keenly. It is the difficulty of portraying the results

of our experiments without affecting some of you who are interested in commercial enterprises. I realize that a few of you believe we go off "half cocked." Before I close, I hope I can convince you that such is not the case. There appears a strong tendency on the part of certain people to either show marked ignorance in reading our bulletins, or else to intentionally misinterpret what we say. Now, listen to this, which was published recently:

WHEN RESEARCHES DEAL NOT IN FACTS.

"Researches of the Forest Products Laboratory at Madison, Wis., are proving of immense value to the lumber industry—these same researches may also prove an immense injustice to some particular branch of the industry. This detrimental feature of a generally commendable and scientific enterprise is forcefully impressed upon West Coast Manufacturers in Bulletin No. 101, United States Department of Agriculture, dealing with the relative resistance of various conifers to the injection of creosote. The bulletin purports to show that creosoting weakens Douglas fir—a conclusion far too sweeping, considering the nature of the experiments."

Now, gentlemen, here is Bulletin No. 101, and I challenge anyone in this Association or any other association to find a single sentence in it which even refers to the effect of creosoting Douglas fir upon its strength. You cannot find in this bulletin a single sentence which says anything about the effect of treating Douglas fir upon its strength, but yet this journal comes out and charges that: "The bulletin purports to show that creosoting weakens Douglas fir—a conclusion far too sweeping considering the nature of the experiments." How would you reply to an attack like that? We, who are public servants, cannot fight our case in the same way you can. Our hands are tied.

It is perfectly possible to pick out of the Bible certain sentences which, if stood by themselves, would cause the Bible to be placed in the class of literature which cannot be sent through the mails. You can pick out of our publications certain sentences which, if considered by themselves, will make it appear that they should be suppressed. But if you consider Bulletin No. 101 in the proper light, I do not believe such conclusions as drawn by Mr. Horrocks can reasonably be drawn.

Now, as I have said, the main point in that bulletin, which may cause misunderstanding, is in regard to creosoted dimension timbers, and on this point I believe that the inserts which I am asking to have made will remove this cause for misunderstanding. We have made in co-operation with a creosoting company on the West Coast experiments to find out what effect creosoting has on the strength of Douglas fir timber. These experiments were begun, I think, something like five years ago. Although we have duplicated these tests and have spent a lot of money and time on them, so far as I know, not a single Government bulletin has yet come out announcing that, according to our resources, the creosoting of Douglas fir weakens it. But I have here a statement from a bulletin of the American Railway Engineering Association published in August, 1914, by Mr. H. B. MacFarland,

Engineer of Tests, A., T. and S. F. Railway, which has absolutely no connection with our work. Mr. MacFarland's general conclusions on the effect of treating Douglas fir are as follows:

> "In every case the treated material shows a decided loss of strength as compared to untreated. The greatest loss is in transverse strength due to the influence of treated sapwood. The loss of compression strength is considerable. The result of the tests indicates the following conclusions relative to the effect of steaming process of creosoted Oregon fir piling: (1) Depth of penetration of creosote was mainly dependent upon the depth of the sapwood; (2) heartwood of Oregon fir piling was almost impervious to treatment; (3) depth of penetration of creosote was the same in the butts as in the tops; (4) depth of penetration of creosote should be interpreted as to mean the depth of active penetration; (5) tests of minor specimens show that injury to fiber through method of treatment is not localized to treated fiber alone, but extends throughout the whole specimen; (6) transverse strength of Oregon fir piling was decreased 42 per cent., due to steaming process of creosoting; (7) compressive strength perpendicular to the grain was decreased 32 per cent. through the steaming process; (8) compressive strength parallel to the grain was decreased 27 per cent, due to steaming process; (9) in general average, the strength of Oregon fir piling subjected to steaming process of creosoting was only two-thirds its original strength.

I have not seen a single published attack on this statement, and yet I just quoted to you a statement from one of our American journals lampooning us for saying something which we never said. We have not yet issued a bulletin showing the results of our tests to determine the effect of treatment on the strength of Douglas fir, but we are going to. As I have already told you our researches on this problem were started about five years ago. We have known for over three years that the "boiling process," as it was practiced, weakens Douglas fir timber. Have you ever seen any statement by the Government in which we announced that fact? Why have we not announced it? Simply because it is our general policy not to make capital of defects in industry and announce them as headlines in the technical papers of the country, but to get busy and try to work out methods whereby the defects can be removed. We have been doing exactly that in creosoting Douglas fir. We have three men in the organization at Madison at work trying to discover a method of creosoting Douglas fir which will not weaken its strength. Now, why are we going to publish our results to date, if what I tell you about our policy is true? Because the Forest Products Laboratory is a National laboratory, and we have been accused by lumbermen in certain parts of our country of deliberately withholding these results, so as "not to injure" the Douglas fir interests and also because we are "prejudiced" in favor of Douglas fir. When our bulletin does come out I think that you are not going to find anything in it to which any man can honestly take exception. I understand that on the West Coast the creosoting companies are per-ing the "boiling" and "steaming" processes and hope that in a short time they will be able to treat Douglas fir without any loss in strength. I certainly wish them every success in their efforts.

I sincerely hope that you, gentlemen, are broadminded enough to believe that we are not "lampooning" Douglas fir or "lampooning" any wood or any process, unless by "lampooning" is meant an announcement of the truth. Our work is National and fundamental. It is aimed at the greatest good for the greatest number, and in pursuing such a policy somebody here and there is going to get "hit." It is inevitable.

While I am on this defensive platform—I never like to be in a defensive position, but I am there now—I want to read another statement to which I must object, which was published in a lumber journal attacking our work. This statement said:

> "It is now known that free carbon particles actually enter the wood; freely in aqueous solutions, less readily when suspended in oils."

(The Preservative Treatement of Wood, Bailey, Forestry Quarterly, Vol. II, No. 1. The Use of Refined Coal Tar in the Creosoting Industry, von Schrenk and Kammerer, Bulletin No. 163, Am. Ry. Eng. Ass'n.)

Now, I call this statement to your attention because we have been accused by the author of it of drawing conclusions on the treatment of timbers or giving erroneous inferences not warranted by the scope of or tests. Let us examine that statement again: "It is now known that free carbon particles actually enter the wood freely in aqueous solutions, less readily when suspended in oil." There is absolutely nothing wrong with it, except that it tells only part of the truth and not the whole truth and, inserted as it is, it gives an erroneous conception to the reader. In other words, most of you in reading that article would think that the free carbon particles there referred to are carbon particles such as occur in refined coal-tar or in coal-tar mixtures. That is the inference which that statement would lead you to make. But do you know what those tests were made with? With pieces of wood about ¼ inch long impregnated with Higgins India ink. I am not attacking those tests but the manner in which the author of the above quotation used those tests. Gentlemen, in a magnification of 700 diameters you can just about see the carbon particles in Higgins India ink. I think it was in the 1913 Proceedings of this Association that Mr. Bond, in connection with his paper, submitted photographic magnification of carbon particles in tar at 400 diameters and, as you can see, they were good-sized ones. Now, it is just as logical to say that because you can put into wood carbon particles of Higgins India ink and then draw the inference that you can put refined tar carbon particles into wood as it is to say that because I can get through a crack in the fence Ex-President Taft can do it. (Laughter.)

I want to make one other point and then I am through. An attack was made on a paper which I prepared for the Eighth International Congress of Applied Chemistry, and recorded on Page 111 of the Pro-

ceedings of the American Wood Preservers' Association dated 1914. This criticism was made by Doctors von Schrenk and Kammerer, and because it is not justified, and is the only criticism against the paper and is recorded in the Proceedings of this Association, I want to reply to it at this time. These gentlemen state:

> H. F. Weiss, in a paper presented before the Eighth International Congress of Applied Chemistry (see Journal of Industrial and Engineering Chemistry, Vol. V, page 377, 1913), refers to some tests made by the United States Forest Service, using the well-known fungus causing the disease of coniferous trees *(Polyporous annosus)*, and from a series of tests he reaches certain conclusions as to the antiseptic value of different constituents of creosote oil. So far as known to the writers, the fungus used never caused a decay of structural timber. This fungus is strictly confined to the root system of living trees, and it can hardly be taken as a fair representative of the fungi which cause decay of structural timber.

In other words, if the position taken by these critics is correct my tests are knocked into a "cocked hat." As I am not a pathologist, as soon as this criticism came to my notice I wrote to Professor Atkinson of Cornell University, who is considered one of our leading pathologists, and asked him if I was correct in saying that this fungus occurred on structural timbers, or if it was confined solely to the root system of living trees. Here is what Professor Atkinson replied:

> In reply to your letter of January 9th I must say *Polyporous annosus* does grow on structural timber especially in moist situations. I have collected it on logs and I have also collected it in considerable quantities on structural timber in coal mines in the vicinity of Wilkesbarre, Pennsylvania. I have had it sent me from such structural timbers by other parties also. It is also known in Europe, I believe, as one of the common enemies to structural timbers in mines. I believe Mr. Humphrey has also collected it from structural timbers in mines.

Professor Atkinson's experiences confirm those of our own section of Pathology.

This point may sound "picayunish" to you, and perhaps it is, but I am contending for a matter of principle as well as scientific truth, and judged from this standpoint I cannot let such attacks on our work go unchallenged. As we are human beings the same as you, we are, doubtless, going to commit errors from time to time, but I want you to feel that whenever we do make errors, they will be corrected to the best of our knowledge and belief. I do not object to frank, open criticism, neither do any of the men associated with me, but I do resent having attacks made upon us from "ambush" as certain members of this Association are doing and in such a way that it is difficult to find out their true source, and gentlemen, so long as I am connected with the organization at Madison, I am going to fight those kind of methods to the last trench.

THE PRESIDENT: Any further remarks on this paper?

MR. AUGUST MEYER: Mr. President, for the last three or four years we have treated a good deal of Douglas fir, and we have experienced just the same trouble as a lot of other people. We have

found that unless Douglas fir is very well seasoned it is hard to get a good penetration and proper absorption. If the timber is green or only partly seasoned when we treat it we have been obliged to steam it, more or less, say from 3 to 5 hours with 20 pounds pressure, holding the creosote pressure from 8 to 12 hours, and still with a treatment like this which ordinarily would not injure any wood, we have found that when the material comes out of the retort it has been more or less warped, twisted, and in a good many cases badly split. When I saw Mr. Horrocks' paper I had in mind to ask him what method he is using whereby he gets such a successful treatment on Douglas fir. Of course, he is not here, so I cannot do so; however, I think it would be mighty interesting for the wood-preservers to know just what method those people out on the Pacific Coast are using by which they obtain such splendid results.

THE PRESIDENT: We have gotten a long way from the paper in hand. While Mr. Horrocks in the latter part of his paper referred to Bulletin 101 the feeling that I had about Mr. Horrocks' paper was that it came to us as a message and invitation to get closer together with out Western friends who were doing such a large part in this industry to help along the conservation of our natural resources, and I would like to drop the other end of the paper entirely. I am sorry that the discussion has followed the channels that it has, and I just want to say the presence this morning with us of four of the Western representatives for the first time, I believe, at least since I have been a member of the Association, four of the prominent representatives of the Western coast timber preservers, leads us to believe that in another year we will have some excellent, thoroughly digestive papers on this subject. If it is the pleasure of the Association I would like to suggest that we drop further discussion of this paper with the hope that at our convention another year we will have this kind of presentation of the difficulties encountered in the preservation of our timber on the Western coast. If that is agreeable we will pass on to the paper by Dr. von Schrenk.

DR. HERMANN VON SCHRENK: Mr. President and members of the Association: Before presenting the paper I wish to call your attention to some small blocks of wood which I brought here with me and which I thought might be of interest to the members of the Association. They contain one of the marine borers, *Martesia striata.* Recently the *Martesia* made its appearance on some of our piling near Appalachicola and as far as I can find this is practically the first time that this particular animal has appeared as a destructive borer in our so-called sub-tropical waters on the Gulf side. I have some of these borers cut out and I would ask you to look at them and not to handle them because this particular lot is about the fiftieth individual that I

have tried to carve out. This particular animal has been known for a great many years as a wood borer in the tropical seas particularly and in all tropical hard wood. It is rather an astonishing-looking animal that many of you may not have seen, and I thought it might be of interest to the members of the Association. The paper which I have to present to you is a very brief one, and I am going to read only a part of it, because most of it consists of figures. You will remember last year we presented the results of a series of tests which we made in response to a considerable demand for some further information as to the relationship which exists between coal tar of various types and creosote oil. This was largely prompted by the fact that it was recognized that a great deal of this particular product was being used, and a great deal of it was being used under what we might call misapprehension. In other words, it was a kind of ostrich policy which many of us were pursuing in regard to this product which was being manufactured on a very large scale, and still no one was willing to come out and actually say what it was all about. In response to a considerable demand we carried on a number of tests on points for and against such a proceeding. Since that time the practice of using coal tar, a combination of various grades and characters mixed with various types of creosote oil, has increased rather than decreased. We all know that we have had more or less difficulty in getting types of creosote oil which we would all like to have, the highly fluid, non-crystalline, light, easily penetrable compound, and we have been put in the position of having to use the best we could. That has rather stimulated the industry of mixing coal tar and creosote, and it has been this economical consideration rather than the technical consideration which has stimulated the practice.

A SPECIFICATION FOR A COAL TAR CREOSOTE SOLUTION.*

By Hermann von Schrenk and Alfred L. Kammerer.

Last year we presented the results of some tests made with mixtures of refined coal tar and creosote, which indicated that when such mixtures consisted of about 20% coal tar and 80% creosote, and oil was produced which could be successfully used for the impregnation of ties, it was found that such an oil penetrated timber to the same extent as the usual heavy creosote oils, provided the mixture or solution was kept at about 180° F. It was recommended that the mixture be made at the treating plants.

During the past year it has become somewhat difficult to obtain the

*By courtesy of the Committee on Wood Preservation, A. R. E. Assoc.

usual supply of high grade foreign creosotes, and there have been increased inquiries for the mixture of coal tar and creosote. It was suggested that the solution of the two substances could be more readily achieved at the plants where the creosote was made than at the treating plants, because it was easier to filter the mixture and thereby reduce the carbon percentage. This brought up the question whether a specification for the finished product could be written, so as to make it possible for a prospective consumer to buy the mixed oil in completed form. In co-operation with the Barrett Manufacturing Company a number of tests were made by the writers to determine distilling points, specific gravities and viscosities of various mixtures. Several coal-tars were selected and these were mixed in different proportions with various light creosote oils. In the following tables the results as determined by us are given. In these tables, A represents the original creosote oil used; B, C and D are three different tars which were mixed in varying proportions with A. There are two series, series 1 and series 2, representing 10 per cent., 20 per cent. and 30 per cent. tar additions to 90 per cent., 80 per cent. and 70 per cent. creosote oil, respectively. The mixtures in the two series are with the same quantity, but the mixtures were made in a slightly different way. In the tables, the percentages of tar added are given with the letters. So for instance, Series 1, B-10 signifies a mixture of 10 parts of tar B and 90 parts of creosote A. The viscosities were determined by means of a standard Engler viscosity apparatus, using 200 c. c. of oil at a temperature of 180° F. This treatment was selected because it is the usual working temperature used in creosoting plants.

It will be noted that the specific gravities and viscosities gradually rose as the percentage of coal tar was increased, as was to have been expected. Based on these and similar determinations a specification was written, which follows herewith:

The oil shall be a pure coal-tar product, consisting only of coal-tar distillates and oils obtained by the filtration of coal tar. It shall contain no admixture of crude tar. Water shall not exceed 2 per cent. Specific gravity at 38° C. shall not be less than 1.06 or more than 1.10. Matter insoluble on hot extraction with benzol shall not exceed 2 per cent. Viscosity (Engler) at 82.3° C. (180° F.) shall not be more than 59 for 200 c. c. No variation above 59 seconds shall be allowed. On distillation by the standard method of the A. R. E. A., it shall yield the following fractions, based on dry oil: Not more than 1 per cent. at 170° C.; not more than 5 per cent at 210° C.; not more than 30 per cent. at 235° C. The residue at 355° C. shall not exceed 26 per cent.

In presenting this specification it should be understood that we regard it by no means final. It is a frank attempt to describe in as few words as possible an oil made up of coal tar creosote, with a certain

TABLE I.

Tests of Materials Used in Mixtures.	Creosote oil A	Tar B	Tar C	Tar D
Specific Gravity at 38° C.	1.036	1.188	1.170	1.164
Water	0.0%	1.0%	Trace	2.4%
Distillation: 170° C.	0.1%	0.8%	0.0%	1.5%
200°	0.9	1.3	0.8	2.0
210°	3.7	2.6	1.3	2.8
235°	40.1	6.9	3.6	6.9
270°	66.5	16.0	11.2	17.8
315°	81.2	23.6	18.1	25.5
355°	92.5	33.0	27.7	36.1
1st Viscosity (seconds)	52.5	171.0	148.5	88.2
2nd "	53.1	175.8	153.6	91.2
Av "	52.8	173.4	151.0	90.0

TABLE II.

TEST OF MIXTURES.	B-10	SERIES 1 B-20	B-30
Laboratory Number	2516	2516	2516
Water	Trace	Trace	Trace
Specific Gravity at 100° F.	1.048	1.061	1.074
Distillation: 210° C.	2.6%	2.7%	3.2%
235°	36.0	30.9	24.4
270°	23.2	21.2	25.9
315°	12.8	14.1	11.6
355°	13.2	15.6	11.6
Residue	11.3	15.5	22.1
1st Viscosity (Seconds)	53.7	55.0	57.7
2nd "	53.9	55.2	57.3
Av "	53.8	55.1	57.5

	C-10	C-20	C-30
Laboratory Number	2517	2517	2517
Specific Gravity at 100° F.	1.054	1.061	1.078
Water	Trace	Trace	Trace
Distillation: 210° C.	1.9%	0.3%	0.7%
235°	32.1	28.0	25.8
270°	26.1	24.8	22.5
315°	14.5	14.8	10.7
355°	13.4	11.8	14.8
Residue	10.7	19.2	24.7
1st Viscosity (Seconds)	52.0	55.0	56.3
2nd "	53.0	55.0	58.0
Av "	52.5	55.0	57.1

	D-10	D-20	D-30
Laboratory Number	2518	2518	2518
Specific Gravity at 100° F.	1.045	1.056	1.071
Water	Trace	Trace	Trace
Distillation: 210° C.	0.2%	0.7%	1.3%
235°	34.5	32.5	27.9
270°	25.6	25.3	22.1
315°	14.8	14.5	13.3
355°	12.8	9.7	12.6
Residue	11.3	16.6	22.1
1st Viscosity (Seconds)	53.5	53.6	56.0
2nd "	52.2	54.3	56.0
Av. "	52.8	53.9	56.0

TABLE III.

TEST OF MIXTURES.	SERIES 2. B-10	B-20	B-30
Laboratory Number	2519	2519	2519
Specific Gravity at 100° F.	1.055	1.067	1.081
Water	Trace	Trace	Trace
Distillation: 210° C.	1.5%	0.4%	1.7%
235	34.7	28.2	28.9
270	23.0	25.6	20.7
315	13.7	12.6	10.3
355	12.3	11.6	12.0
Residue	13.9	21.1	25.0
1st Viscosity (Seconds)	55.0	56.0	59.0
2nd "	54.8	56.0	59.2
Av. "	54.9	56.0	59.1

	C-10	C-20	C-30
Laboratory Number	2520	2520	2520
Specific Gravity at 100° F.	1.053	1.068	1.083
Water	Trace	Trace	Trace
Distillation: 210° C.	0.3%	0.1%	0.5%
235°	30.4	25.6	24.7
270°	26.5	26.4	21.9
315°	14.3	13.1	13.1
355°	12.6	12.3	12.5
Residue	15.0	21.7	27.0
1st Viscosity (Seconds)	55.2	56.0	58.3
2nd "	55.0	55.8	59.7
Av "	55.1	55.9	59.0

	D-10	D-20	D-30
Laboratory Number	2521	2521	2521
Specific Gravity at 100° F.	1.049	1.053	1.074
Water	Trace	Trace	Trace
Distillation: 210° C.	2.4%	0.7%	1.1%
235°	36.3	30.1	21.2
270°	23.0	23.1	24.5
315°	13.7	14.8	13.7
355°	11.9	12.2	14.7
Residue	12.3	18.3	24.4
1st Viscosity (Seconds)	53.5	55.0	56.3
2nd "	53.0	55.2	56.1
Av. "	53.2	55.1	56.2

percentage of coal tar. The writers have had occasion to examine a number of samples purchased under this specification, and found that they came within the prescribed limits. The justification for such a specification lies in the fact that a mixture of the two substances was being prepared for general use and sold in large quantities. This has previously passed more or less as creosote oil. The present specification states in so many words that a mixture is contemplated. It is hoped that the writing of this specification will bring forth suggestions as to improvements.

In this connection it should be pointed out that a largely increased consumption of creosote and an increased application of creosoted materials will depend very largely upon the confidence which a purchaser will have in getting the product which he is paying for. There has probably been justified criticism because of practices in connection with creosote in the dim and distant past, sometimes referred to as the day when anything which looked black and smelled bad passed any specification for creosote oil. We all know that excellent results have been obtained by the use of creosote conforming to all kinds of specifications. All the oils, however which have given good results have been coal tar oils. The fact, that they differed widely in some respects has resulted in the omission of apparently unimportant requirements in our modern specifications, such as percentages of tar acids, flash point, etc., and has tended to simplify the specifications. There is nothing about the industry which is not capable of rigid examination. It should remain so, however. The recent increased admixture of water-gas tar with creosote is hardly to be regarded as a step in advance. If water-gas tar is worth anything at all, why not state frankly that it is being used. The same course is apparently being followed with this substance as was the case with the coal tar addition. Let us use every effort to stimulate the use of whatever preservative is used under its own colors. It is a hopeful sign that the day is not far distant when creosote distilling plants will sell their product subject to inspection as it comes from the stills. In the minds of many consumers there has been too much connected with this industry which has been mysterious. There is no reason for this, and there ought to be none. We offer the specification for a coal tar creosote solution as a step toward a better understanding of one phase of the industry.

During the reading of the paper Dr. von Schrenk interpolated the following:

During the last year in co-operation with the Barrett Manufacturing Company we made a number of different mixtures, using typical

coal tar of known chemical composition and mixing these with a standard creosote oil. In the tables we have presented in this paper the results as determined by us are given. It will be easy to refer to these tables and examine the results. The letters A, B and C refer to the tars and figures following the letters in each series represent the percentage of coal tar mixed with a certain percentage of creosote oil, from which we get combinations 10, 20 and 30 and determine the distilling points, the viscosities and the usual water percentages.

That specification is one which says practically very little more than that the material is a coal-tar compound and we frankly recognize the fact that it is a combination or a solution, because I don't like the word mixture. It is really a chemical solution, a solution which shall practically have a reduced amount of residue and which shall have a specific viscosity, both of which points will more or less materially tend to hold down the percentage of the amount of coal tar which it would be possible to put into the solution. You will note that the important features of this specification are that there should be very little distilled below 200°; that a maximum of 26 per cent. is allowed for the residue above 355°, and that the viscosity in no instance, when using the standard Engler apparatus, 280°, shall not at any time exceed 59 seconds.

THE PRESIDENT: We have one written discussion by Mr. Hendricks, of the Frisco, on this paper which we will now have read.

Secretary Angier then read the written discussion as follows:

DISCUSSION ON A SPECIFICATION FOR A COAL-TAR CREOSOTE SOLUTION.

By V. K. Hendricks.

While I cannot offer any constructive discussion on this paper, attention is called to the fact that the authors themselves do not consider their suggested specification as being at all final; and in view of our lack of information I should personally be inclined to have the creosote and tar procured separately and mixed under the direct supervision of the user rather than to purchase a preservative under a specification which might not prove to be what is desired. There is, of course, a chance of having a mixture furnished as creosote oil instead of having straight creosote oil furnished, but I should personally prefer at this time to accept that risk rather than the risk of an untried specification, in case I were using a mixture of tar and creosote.

In their paper the authors make no mention of free carbon, except that the specification provides that the oil shall consist only of coal-tar distillates and oils obtained by the "filtration of coal-tar." So far as I am aware, the tar which has been used in admixture heretofore has not ordinarily, if in any case, been filtered, but it was obtained from

such sources that the amount of free carbon was comparatively slight.

In the paper by Mr. F. M. Bond on "Some Tests to Determine the Effect Upon Absorption and Penetration of Mixing Tar with Creosote," published in our 1913 Proceedings, some of the conclusions given on page 273 are as follows:

3. There was no apparent relation between the viscosities and specific gravities of mixtures of creosote with the three carbon-free tars and the corresponding absorptions and penetrations into longleaf pine.

7. There was no apparent relation between the amounts of free carbon in mixture of creosote with the three normal tars and the corresponding absorptions and penetrations into longleaf pine.

8. There was no apparent relation between the vicosities and specific gravities of mixtures of creosote with the three normal tars and the corresponding absorptions and penetrations into longleaf pine.

Judging from the results of Mr. Bond's experiments it would seem that the question of free-carbon content and the size of free-carbon agglomeration should be given further investigation.

There are no doubt a number of other questions on which additional information should be obtained before a thoroughly comprehensive specification for a mixture of tar and creosote can be drawn.

DR. H. VON SCHRENK: May I make a reply to one or two criticisms?

THE PRESIDENT: Yes.

DR. H. VON SCHRENK: As I understood it was said that there is no reference to the free-carbon question in this specification. I would like to refer to the specification, which says in the second line: "Matter insoluble on hot extraction with benzol shall not exceed 2 per cent."

THE PRESIDENT: Mr. Hendricks, will that answer your criticism on that point?

MR. V. K. HENDRICKS: Yes.

MR. A. E. LARKIN: We would like to present a discussion somewhat along the same lines. When this paper was presented we found that the question raised by Dr. von Schrenk was one that interested our company very much, and I asked Mr. Reilly to prepare a paper to be presented at this time, for I wished to read it in connection with Dr. von Schrenk's paper in order to give two sides of the matter and to encourage further and freer discussion of the question.

DISCUSSION ON A SPECIFICATION FOR A COAL-TAR CREOSOTE SOLUTION.

By P. C. Reilly.

Dr. von Schrenk undoubtedly submitted his paper for the purpose of encouraging discussion on creosote oil and of its mixture with coal-tar and probably, as well, with the view of having the American

Wood Preservers' Association decide upon a proper classification of the mixture of coal-tar and creosote oil. He submits the term "A Coal-Tar Creosote Solution" for consideration as a proper designation for the mixture of coal-tar and creosote oil.

There are, therefore, in his paper three points to consider:

1st. The mixture of coal-tar with creosote oil and the quality of this mixture.

2d. What name should be given to the mixture or coal-tar with creosote oil.

3d. Creosote oil.

The term "Coal-Tar Creosote Oil Solution" cannot be adopted for the mixture of tar with creosote oil because it is not descriptive of the mixture. It is without specific meaning, because of its failure to designate the material to be dissolved in making the solution. If the term "solution" is to be used to describe the addition of coal-tar to coal-tar creosote oil it should be expressed in the following words: "Creosote Oil Solution of Coal-Tar;" and if petroleum-tar is added to creosote oil it should be described as "Creosote Oil Solution of Petroleum-Tar." The tar is the article dissolved, and the "solution," therefore, is a tar solution. For instance, when zinc is dissolved in water, the water being solvent, we do not classify it as a water solution. Such a designation would be incomplete and, therefore, meaningless. The article dissolved is zinc, and the resulting solution is a zinc solution, classified as such. Water is the solvent for the zinc; creosote oil is the solvent for the tar. For these reasons I believe the mixture should be characterized as a "Creosote Oil Solution of Tar"— the kind of tar used, whether coal-tar or petroleum-tar, to be designated specifically.

It is difficult to imagine any article of commerce being treated so badly and unscientifically as creosote oil has been. The manufacturers of it, until very recently, were careless in its production, and its quality has been good and bad and consequently very uniform. We should not further impose upon it by adulterating it with coal-tar and make its name, as in the case of the suggested description, carry the burden of the adulteration without mentioning the adulterant. It will be observed that although the purpose of the specification is to permit the use of coal-tar, the word "coal-tar" as referring to the material itself, is omitted from the suggested designation for the specification. Its use as an adjective in qualifying the creosote oil is all right, but you will notice it in no way refers to the adulterant used.

Another criticism can be made of the specification submitted by Dr. von Schrenk, which will probably lead to the production of a clearer and more easily understood specification than the one submitted by him. His specification reads:

The oil shall be a pure coal-tar product, consisting only of coal-tar distillates and oils obtained by the filtration of coal-tar.

Here again the word "coal-tar" is omitted and the word "oils" improperly substituted therefor. Coal-tar filtered is coal-tar. Filtration simply removes the free carbon and other foreign substances. There are no oils filtered out from coal-tar. This specification, therefore, whenever used should be written as follows:

> The oil shall be a pure coal-tar product, consisting only of coal-tar distillates and filtered coal-tar.

Dr. von Schrenk further states:

> The mixtures in the two series are with the same quantity, but the mixtures are made in a slightly different way.

I wish he would explain how the mixtures were "made in a slightly different way" yet when tested gave different results, as shown in Tables II and III.

Those engaged in the wood-preserving industry should discountenance the use of any adulterant and should instead exert their efforts to improve the quality of their products by improving the quality of the oil used. With the exception of the action of the American Railway Engineering Association to establish a specification for tie treatment of uniform quality, and the determination of some cities to establish a standard of quality for wood paving blocks, there has been no general or consistent attempt made to improve the quality of this important commodity. The improvement by the American Railway Engineering Association consisted only in establishing a standard for the oil being offered them; it made no attempt to improve the quality of the commodity itself. This record is not a very enviable one for the product itself or for its manufacturers.

Coal-tar distillers and wood-preserving people have invited criticism, because of the indifference they have shown in the manufacture and production of creosote oil. We are at present doing nothing more than working with a grade of creosote oil prepared by Bethel nearly 100 years ago. This is not advancement. In Bethel's time a mixture of tar and creosote oil was tried, but discontinued, because it was found that the tar was only an impediment to the injection of the creosote oil. I do not know the carbon content of the coal-tar used at that time, but it was probably somewhat higher than the present coke oven tars. But even using filtered coal-tars the pitchy part of the tar remains on the surface of the timber and acts as an impediment to penetration.

It is clear that it is a step backward to mix tar with creosote oil, because anything that debases or affects adversely the quality of a product is a backward step. The admitted inferiority of the adulterated oil alone should bring its condemnation and prohibit its serious consideration.

Is it not astonishing that with nearly a century's experience behind us and with the present-day progress and advance in other branches of industry that we have nothing better to suggest than the adulteration of an article upon which the very success of our industry is based? If improvement were impossible, and if all efforts to make creosote oil better and more efficient had proved failures, then there might be reason for us to cling to Bethel's grade of pure creosote oil; but there can be no excuse for adulterating it. But improvement in the quality of creosote oil is not impossible. The experience we have had and the data at hand conclusively show us that we can produce the quality of creosote oil best suited to our purpose. It is easy to improve upon the present qualities of creosote oils; therefore, why should not the attitude be to do so and move forward a step rather than backward? If we are not willing to move forward we should at least be willing to cling to that which has proved comparatively successful.

I am aware that the claim has been made, and, no doubt, will be made again when this paper is concluded, that the reason for the proposed adulteration of pure creosote oil with tar is a commercial necessity; that there is not nearly enough oil produced in this country to supply the demand. I also expect the falling off in importations in 1914, on account of the war, will be advanced as a reason for a permissible adulteration now. In any discussion of the supply of oil, the temporary war condition should not be advanced as a reason for the adulteration, or for the need of it, because the adulteration of creosote oil has been going on for years and years, and it was then, as well as now, in no way related to the supply of material at home or to the importation from abroad. An analysis of the percentages of coal-tar to be mixed with creosote oil, as suggested by Dr. von Schrenk, will, I think, dispel the supposed necessity for the adulteration, because of the shortage of our creosote oil production. Roughly speaking, our consumption of creosote oil is 100,000,000 gallons annually, of which 40 per cent., or 40,000,000 gallons, is produced in this country. If we add 10 per cent. of coal-tar to it, it means an added production of 4,000,000 gallons; if we add 20 per cent., it means an added production of 8,000,000 gallons; if we add 30 per cent., it means an added production of 12,000,000 gallons. Assuming that it would be permitted to adulterate all of the home production, we would still be short, respectively, 56,000,000, 51,000,000 and 48,000,000 gallons, which we would have to get from abroad. This assumes also that all of this tar will prove to be a preservative and penetrate the timber, which, of course, is not the case. But these figures, even if taken in the exaggerated form as here given, show that the adulteration will not bring any measurable relief, that we would still have to depend upon Europe, and that to get this alleged increase it would be necessary to convert a large volume of

first-class oil into a slightly increased volume of inferior oil. It seems to me that the result of the theory repudiates the theory and shows that it is a matter not warranting serious consideration. But it might be asserted that the adulteration in the proportions mentioned could be added to the total quantity of creosote oil, imported and domestic. I think to assume that the buyers of substantially one-half of the oil consumed might be willing to use a mixture with the mark of inferiority stamped upon it is assuming that a very large—too large—a proportion would accept the adulterant.

It is difficult to understand the persistent efforts in recent years to promote the adulteration of creosote oil with coal-tar. It is acknowledged that the adulterated mixture is inferior to the unadulterated creosote oil. And the figures show that no real relief from the shortage in production in this country is obtainable by the use of tar. The question of the use of tar as an adulterant in the creosoting industry must, therefore, be purely a commercial one with those having the tar to market and with which treating engineers and those engaged in the promotion of the wood-preserving industry have no connection, because they do not understand, and should not be expected to understand, the actual basic conditions with respect to the coal-tar industry. All of us are inspired by the same high motive as Dr. von Schrenk, that if the material is not to be had first in this country, or second from abroad, then seek something else in this country to supply the deficiency. The field is here to obtain the suitable material if we seek it. And if the coal-tar distillers properly co-operate with those engineers in wood-preservation as well as with the consumers of creosote oil the production of oil in this country could be considerably increased above the largest quantity of tar which Dr. von Schrenk recommends as a partial relief from the shortage existing. The delinquency in this matter can be traceable to those engaged in the coal-tar industry.

Not long ago one of our engineering papers published the fact that a large quantity of coal-tar had been destroyed and kept from the market. Whether it was destroyed to keep it from the market or not is not material. The fact that it was destroyed, while there existed a shortage of creosote oil, is material; and this destruction has prevailed in the coal-tar industry for years. There is an old proverb: "Waste not, want not." It is also a truism that you cannot destroy a thing and have it too. Suppose that instead of destroying this tar for years and years, when the importations of creosote oil were increasing to supply a large local demand, it had been refined, and 33 per cent. to 40 per cent. of it had been saved in the form of creosote oil, and the refuse, if useless, thrown away, what would have been the present condition? The supply of creosote oil produced would have been so large that it would, I am sure, easily have satisfied any deficiency

which occurred beyond the present supply. Would it not be better for the American Wood Preservers' Association to go on record as advocating the conservation of coal-tar, the source of creosote oil, and converting as much of it as possible into creosote oil, thus increasing the quantity rather than favor the debasement of the product? Would not such a course be more in keeping with the object of the Association than to approve so uneconomical an expedient as is being advocated and one that would cause us to regulate our business so as to conform to such destructive policy? I contend that there is no necessity for debasing our material by adulterating it with coal-tar. Instead of making coal-tar a debasing medium, the coal-tar interests should not only improve the quality of their creosote oil, but should also increase their production of it by not wasting the raw material, especially when the waste creates an artificial shortage.

I have found that the degree of penetration of creosote oil is reduced by the addition of coal-tar, and the larger the addition of the tar to the creosote oil the greater the decrease of the penetration of the "solution." This is a natural consequence, resulting from the addition of a material (tar) having a very high viscosity and low co-efficient of penetration. In fact, the so-called "solution" (tar added to creosote oil) is not altogether a solution, but in part a mixture, and that part of the material which is not entirely dissolved is separated from the solution by the straining nature of the wood fibre, which acts as a filter cloth when wood is treated with the "solution," and there is deposited on the surface of the wood a heavy viscous pitch. This dense, pitchy coating is the element which hinders the free and even penetration of the solution.

The mixture of the tar and creosote oil, in comparison with the pure creosote oil, will illustrate very nicely that there is no relation between viscosity and gravity, and also that there is no relation between viscosity and penetration. The tar mixture in the viscosimeter tests acts as a mixture of oil and water, thoroughly mixed, will act. The mixture would flow through the viscosimeter without separation and its viscosity would be recorded. But if this mixture of oil and water is filtered, the water will filter out from the oil. So, with the tar mixture, when it meets with resistance, as it does when it comes in contact with the timber, the oil filters out from the pitchy tar.

I have made tests with the Tagliabue viscosimeter, using the percentages of tar in mixture with creosote oil mentioned in Dr. von Schrenk's paper, and have compared each of the mixtures containing 10 per cent., 20 per cent. and 30 per cent. of tar with pure creosote oil itself with the following results:

	Creosote	Tar	70% Creo. 30% Tar.
Sp. Gr.... 38°C	1.036	1.18	1.076
Distilling to 200°C	2.0	1.00	1.01
" " 235°C	43.5	9.20	24.02
" " 315°C	81.8	23.50	64.30

Viscosities at 180°F.

Creosote Oil, Sp. Gr 38°C	1.036	60.20
" " " " "	1.075	64.20
" " " " "	1.110	68.40
" " " " " and Coal-Tar " " " "	1.036–70% 1.180–30%	.....68.25

I have also taken a creosote oil heavier in gravity than the tar mixtures advanced by Dr. von Schrenk, and I have observed that the heavy creosote oil has a lower viscosity than the creosote oils adulterated with tar. Dr. von Schrenk makes the statement that the viscosity of the tar mixture increased in proportion to the increase of the gravity, as the percentage of tar in the mixture increased, and he states that this might have been expected. It is to be expected from a mixture of tar, not because of the increase in the gravity of the material but because of the pitchy non-penetrating substance in the tar—from the very nature of the material itself and its lack of mobility. An increased viscosity under such conditions as stated by Dr. von Schrenk is due to the pitch in the tar, which substance it is known interferes with the penetration of the mixture into the wood. Conversely, take the viscosity of the tar itself. Dissolve the tar in creosote oil, and as the percentage of the creosote oil is increased, the viscosity of the material will be decreased. The viscosity of pure creosote oil, of the same gravity as the tar mixture, is much less, showing there is absolutely no relation between viscosity and gravity of these materials. This increased viscosity of the tar mixture explains why any engineer or person skilled in the treatment of timber considers the pure creosote oil as a better medium for treating wood than when it is adulterated with tar or any other material which acts as a retardent to the penetration of the oil.

The oil used in our industry should have the greatest penetrating qualities, should be high in antiseptic properties and should not be subject to great volatilization under natural weather conditions, qualities of highest importance for treatment of railway ties and paving blocks.

I have, I hope, set forth three cardinal principles for your consideration:

First. That the adulteration of creosote oil with tar is unwise, and, from a commercial standpoint, both as to increasing the quantity of the preservative by mixing creosote oil and tar and the use of this mixture, unnecessary, and certainly inadvisable.

Second. That as the mixture of tar with creosote oil detracts from the quality of the wood-preserving properties of the creosote oil, it should not be used.

Third. That whenever either coal-tar or petroleum-tar is used for wood-preservation, the name of the tar so used should be frankly set forth, both in the caption of the specification and in the specification itself.

MR. A. E. LARKIN: I wish to call your attention to a section from the Constitution and By-laws which I shall read as follows:

> "Sec. 2, Art. I. The objects and purposes of the Association shall be to advance the wood-preserving industry in all its branches; to afford its members opportunities for the interchange of ideas with respect to improvements in the wood-preserving industry, and for the discussion of all matters bearing upon the industry of wood-preserving; to maintain a high business and professional standard in all respects, and to standardize specifications for wood preservatives and their introduction into the materials to be preserved."

Here is the policy set forth for us to follow. We presented this discussion at this time so that it can come before you at the same time that Dr. von Schrenk makes his contribution to the program. In commenting on Mr. Reilly's and Dr. von Schrenk's papers I can properly ask the question of this Association: Is the backward step taken by mixing creosote oil with tar in harmony with the stated purposes of our organization as set forth by the above quotation from our Constitution and By-Laws? I thank you.

THE PRESIDENT: I would just like to say one word here. We appreciate this full discussion of this subject very much and are pleased to have these written contributions or criticisms on our program. The one point that may have been overlooked, however, is that the Association does not expect to take up at this time the adoption or rejection of this point presented by Dr. von Schrenk. Fortunately, I think very fortunately, the Association work is to be carried on in the line of specifications by standing committees, and these discussions, both by Dr. von Schrenk and Mr. Reilly as presented by Mr. Larkin, and other discussions of that nature, are valuable additions to our program; but we will finally leave the adoption of specifications for preservatives to our standing committees after a year's deliberation. With this understanding we will ask for any other remarks that anyone has to make on this paper.

MR. EDW. F. PADDOCK: Dr. von Schrenk speaks of the time required for his oils to pass through the Engler viscosimeter. These instruments are standardized against water, and I would like to know what the standard for pure distilled water is for the viscosimeter that the Doctor used in order that I, myself, and others can compare his

results with our own. Viscosimeters differ, and each one is standardized individually. Furthermore, in regard to the free carbon, I think Dr. von Schrenk not only covers the elimination of free carbon in his benzol test but also on another page in this report where he speaks of a mixture to consist only of coal-tar distillates and oil obtained from the filtration of coal-tar. There he eliminates the free carbon, if he does not in his benzol test, but if there is any doubt, I do not think it would do any harm to specifically introduce it here, using the term "free carbon" in his specifications. As far as the title is concerned the objection I think could be overcome by simply hyphenating the title, making it read "A Specification for Coal-Tar-Creosote Solution."

THE PRESIDENT: Could I ask the Doctor what the water basis was?

DR. H. VON SCHRENK: I have forgotten the exact figure, but it is somewhere in the neighborhood of 53.

MR. L. B. MOSES: Mr. President, I am not going to attempt to discuss a creosote specification, because I do not know anything about creosote. Like a great many of our members I must rely on what the experts like von Schrenk and Reilly tell us about these different oils, but the assumption that such a series of experiments as Dr. von Schrenk is carrying on would not be of material advantage to the industry if they worked out successfully seems to me to be a very dangerous viewpoint to take. Two gallons of tar, for instance, cost less than one gallon of No. 1 A. R. E. A. creosote. If these experiments help us to get a specification which will reduce the margin between the cost of an untreated white oak tie and a creosoted red oak tie, for example, we will certainly have done a great deal to advance the cause of wood-preservation. That item is one that is of tremendous importance to all of us who are engaged in the commercial treatment and sale of cross ties. The thing that is holding back the advancement of the creosoting of ties, or the treatment of ties with either creosote or zinc or a combination of the two today, is the fact that untreated ties can be purchased so much cheaper than the treated ties. If we can get any specification which will preserve the tie for its full mechanical life, and reduce the cost of treatment as compared with the cost when terated with the highest grade of creosote oil, why, of course, that is going to be of tremendous advantage to us. It is certainly hoped that these experiments of Dr. von Schrenk will be put up in that light to the American Railway Engineering Association's Committee so that we can get as strong a recommendation as possible in the report that Mr. Stimson spoke of, which is to be made in March. From the tie standpoint that is very important.

MR. A. E. LARKIN: Mr. President, this is another case where a careful analysis, of course, could not be made of this discussion as

presented, but an analysis of the discussion will disclose that we refer especially to the terms used to designate the various mixtures, and to persuade, if possible, this Association to take steps upward all the time and to promote to the greatest extent a larger production of the high-grade materials.

MR. A. L. KUEHN: Mr. President, the point in Dr. von Schrenk's paper that interested me very much was his reference to the inspection of material. We would not any of us think if we were purchasing creosoted timber of accepting it without rigid inspection of the work at the plant. Now, creosote oil or creosote has become entirely too important an engineering material to be taken without proper inspection. It has been produced under a veil of secrecy. The material itself has often been a very secret mixture. What engineer would think of purchasing steel rails without seeing the material manufactured step by step? That feature I think has been overlooked in all our specifications, and I think somewhat to the discredit of engineers who have gotten up these specifications. If it had been any other material with which they were better acquainted they would not have hesitated to insist on "shop" inspection, if you please. A clause should certainly be included in any specification for oil, particularly in view of this discussion of the question requiring that the material should be inspected as made. I think that may meet some opposition, but you will pardon the reference I want to make to emphasize my point. I am glad to say that one concern, the concern with which I am connected, the American Tar Products Company, is writing its specifications, requiring that the inspector shall be at the works to inspect the material made and see that he gets everything that is called for in the letter of his specifications.

MR. WM. H. FULWEILER: I think one of the most interesting features of this paper is the attempt to come out in the light and openly advocate putting on a label that will pass pure-food inspection of the products that are being sold for wood-preserving purposes. It is a point I have been feeling very strong about myself from the interest that our company has in this work, which, of course, compared to the total amount, is rather small but important, nevertheless, and I am mighty glad to see that so able an authority is coming forth and recommending that we test exactly what is in the material. Of course, I do not know whether I should favor knocking another man's product so vigorously as has been done here, but I would like to feel that probably in the words of the headline on one of the sporting pages of a Philadelphia paper: "Every knock is a boost." I think that the bald statement such as "all the oils which have given good results have been coal-tar oil" is not justified by records, which Dr. von Schrenk must have access to, and which are known perfectly well to a great many people in the Association. I do not feel that I could sit by and let such a statement go

entirely unchallenged. I do not think it is good form. I do not think it is true. I know it is not true, and I do not think it helps the paper to make such statements.

MR. C. M. TAYLOR: I only want to reiterate the statement that I made yesterday, that is, that I care less for the kind of oil that is used than I do for the timber that we do use and the penetration we do get. I think the majority of the discussion this morning has been irrelevant to the question of timber preservation. I once was in commercial work, and I am now in railroad work and I think for the sake of the Association that all these questions of specifications or details such as presented by Mr. Reilly's paper should be presented to the Committee on Specifications, not on the open floor of this convention. I also would like to have the preacher follow his text in that paper by specifying clearly in the specifications the kind of tar used in the tar solutions.

THE PRESIDENT: This point was brought out solely, of course, by Mr. Reilly's paper, and if there is no other discussion, I want to say that I highly appreciate Mr. Kuehn's remarks that his company is now making it possible for the purchaser of this kind of product to investigate its manufacture. It is a step in advance, and I appreciate knowing that this step is being taken, because publicity is what we want. We want this in the whole treating business, and the quicker it gets on a basis where we all know what we are doing the quicker will we treat the quantity of material that we should treat. When you realize that there is only 30 per cent., or approximately 30 per cent., of the railroad ties alone, let alone the building material and vast quantities of other material that is not treated are preserved at all, the force of Mr. Moses' remarks will come home to you.

DISCUSSION ON A SPECIFICATION FOR CREOSOTE OIL.

By J. C. Williams.

This is an avowed attempt to write a specification recognizing the serviceability of a mixed oil and the commercial expediency of using it.

As such, it is deserving of all commendation and marks the first step which will, we trust, eventually result in simplified operating conditions, and the disappearance of the voluminous specifications which have been the obsession of many recent writers and committees who have given their attention to the subject of creosoting.

It is noted that this specification permits the presence of not more than 2 per cent. of matter insoluble on hot extraction with benzol, and this is necessary if the mixture consists of creosote oil and coal-tar.

It is also suggested that the coal-tar be filtered to reduce the percentage of free carbon. This naturally increases the cost of the tar,

and I have heard it argued by oil producers that the filtered tar is thereby rendered as expensive as the distillate or creosote itself, so that the only result of using a mixed oil is to spread the available creosote over a greater quantity of material.

There is a possible mixture to which I wish to draw attention, which will have no more matter insoluble in benzol than the pure distillates or creosote oils and which will be less expensive than the coal-tar creosote solution covered by the paper under discussion. I refer to a mixture of dehydrated water-gas-tar and coal-tar distillate, or creosote.

Assuming the cost of creosote to be 100, the water-gas-tar will be 50, so that a mixture of say 80 parts of creosote and 20 parts of water-gas-tar will cost 10 per cent. less than the same volume of pure creosote, and as I stated in the beginning will be practically free from the carbon necessarily allowed by the proposed mixture or solution of coal-tar and creosote.

According to Messrs. Dean and Bateman (Circular 112. Forest Service, U. S. Dept. of Agriculture) the high refractive indices of the oils from water-gas-tar, as well as the small amount of unsulphonated oils in the high boiling and largest fraction above 315° C., indicate that the hydrocarbons of which they consist belong to the aromatic rather than the paraffine series, and are of the same class as the clear oils from coal-tar creosote.

In a paper before the Society of Chemical Industry, Feb. 28, 1911. Mr. J. M. Weiss gave the results of some tests with gray moulds in a broth consisting of Agar-Agar, Malt Extract and Liebig's meat extract. These tests were made to determine the antiseptic properties of creosotes and tars. He found that 0.15 per cent. of coal-tar creosote stopped the growth of the mould and that 0.9 per cent. of water-gas-tar distillate had the same effect. Similarly 2 per cent. of undistilled coal-tar and 13 per cent. of undistilled water-gas-tar also stopped the growth of the moulds.

These two references are for the purpose of showing that the water-gas-tar partakes of the nature of coal-tar, having present in its make up aromatic hydrocarbons similar to those recognized as valuable antiseptics, and that as would be expected from this fact the water-gas-tar possesses certain inherent antiseptic qualities of its own which while of not so strong a character as those of the coal-tar are sufficient to justify its use either alone or in admixture with creosote for wood-preserving purposes, especially in treating railroad ties and paving blocks.

The weight of a cubic foot of yellow pine varies from 30 to 45 pounds. A fair average weight is probably 38 pounds.

A 10-pound treatment will insure the presence of about 25 per cent. of preservative by weight in the timber, and inasmuch as Mr. Weiss has shown that 13 per cent. of water-gas-tar will prohibit the growth of moulds in broth cultures it appears that a 10-pound treatment of water-gas-tar is enough preservative to provide sufficient toxicity to prevent decay, while with the substitution of water-gas-tar for coal-tar in the proposed mixture the high factor of toxicity of the creosote will be sufficient to prevent decay, even though the water-gas-tar had no toxic value, and we still retain the advantage of less cost and less insoluble matter as arguments in favor of the use of the water-gas-tar in the proposed mixture or solution in preference to the coal-tar, and I offer this as a suggestion and improvement as requested by the authors.

This paper also touches on the desirability of calling various preservatives by their proper names. In this connection I wish to point out that in the "Engineering Record" of April 16, 1910, C. N. Forrest, Chief Chemist of The Barber Asphalt Paving Company, in a paper entitled "Preservatives for Wood Paving Blocks," suggested that the word creosote be restricted to cover distillates only of the coal and other tars which consist essentially of hydrocarbons of the aromatic series.

This has been elaborated by C. P. Winslow of the U. S. Forest Service (Circular 206) and also by a committee of this Association, and I think of the A. R. E. A.

I know of large quantities of water-gas-tar being used successfully as a wood-preservative and sold as water-gas-tar and fail to appreciate why anyone would wish to conceal its use any more than they would seek to conceal the admixture of coal-tar to a creosote distillate.

The authors state there have been deceptions along this line in the unauthorized use of coal-tar which they propose to overcome by their new specifications.

My idea would be to remove all temptation for deception in the use of water-gas-tar by recognizing it as a true wood-preservative, and giving it a recognized standing on the basis of Mr. Weiss' experiments, the tests of Dean and Bateman, and the experience of those who have used it continually and successfully for certain types of work.

Should any committee of this or any other association or any individual honestly interested in investigating the true worth of this material desire to go into the details of this subject I would be glad to have them call by appointment at my office and inspect the records and reports covering the use of water-gas-tar as a wood-preservative over a period of more than seven years, and I will refer them to well-authenticated pieces of work where water-gas-tar is the preserving agent.

THE PRESIDENT: Now, we will close this discussion on this paper, and I am going to ask your indulgence for just a few minutes more to read a short paper by Mr. Noyes.

Mr. Angier then read the paper prepared by Mr. A. H. Noyes, as follows:

AIR SEASONING OF CROSS TIES.

By A. H. Noyes.

The successful handling of softwoods, particularly beech and gum, is a matter that is worthy of serious consideration. The ever increasing shortage of oak timber of all species makes the adoption of softwoods a necessity, but the character of softwood timber requires careful handling to insure the delivery of sound timber to the treating plant, and thereby a serviceable tie to the consuming road.

Throughtout the central section of the United States, and more particularly that part known as a tie producing region, there is probably a larger acreage of beech and gum than any other tie material, pine excepted; beech being common in most of the bottoms and gum in the low lands, Missouri and Arkansas having thousands of acres of gum that will eventually come in for tie purposes.

Owing to the structure of the timber, beech ties are nearly always sawed, beech timber being too hard to hew, and on seasoning, get rough or scaly. On the other hand, gum timber hews easily and makes a smooth, pretty tie

When gum or beech ties are produced tributary to a railroad, it is advisable that they be shipped into the treating plant as promptly as possible, after being made, and seasoned at the plant in preference to seasoning on the line of the road, as, in this event, the ties can be stacked for seasoning under more satisfactory conditions, and can be loaded for treatment at the proper time; in fact, the entire process kept under more complete supervision and control, than under other conditions and in this manner avoid the possibility of damaged timber reaching the treating plant.

It is an accepted fact that all ties, softwood ties especially, should be carefully piled, never on the ground, but on sound stringers, and either with spacing strips between layers, or that they be piled so that the faces do not have full bearing against each other, as experience has shown that ties piled close soon show damage.

Experience on river territories shows that it is not safe to buy softwood ties while the sap is up, no matter how carefully the ties are piled for proper seasoning, as transportation during the summer is not to be counted on with any amount of security and ties are liable to be damaged before they are loaded for shipment. Besides this, softwood ties piled on river landings are, in some cases, in deep shade, or, where in the open, are frequently surrounded with a rank growth

of weeds, that tends to hold the moisture, creating conditions favorable to rapid damage. For this reason, the practice of buying softwood ties at small landings should be avoided, and ties should be hauled to only such landings, where they are handled in large quantities; where the timber will be exposed to sunlight and free air currents; where landings are free from weed growths and where shipments can be made by date rather than by appearance of the timber.

That softwood must and will be used for ties is positive, as the supply of oak is diminishing in quantity and accessibility. That beech and gum make a good tie, when properly handled and properly treated, is an accepted fact and with an available supply of softwood timber in easy reach of transportation, it is desirable that the question be given serious consideration and the methods and means of handling be freely discussed to promote a more general demand among consuming roads and to offset a well established unjust prejudice against their use.

METHOD OF BUYING AND INSPECTING TIES PRODUCED ALONG THE RIGHT OF WAY.

By W. F. Goltra.

The discussion of Mr. Noyes' paper was deferred along with several others for lack of time, and I desire to submit in writing the remarks which I intended to make.

When I took charge of the purchase and inspection of cross ties for the New York Central Lines, west of Buffalo, in November, 1907, I found it was the practice on the Big Four to inspect and accept ties intended for treatment on the right of way and allow them to remain there for seasoning until taken up by a work train for shipment to the treating plant at Shirley, Ind. Numerous complaints were received from our inspector at the treating plant regarding the quality and condition of the ties. A very large percentage were undersize and badly manufactured, and a great many were so rotten as to render them utterly useless. Complaints of various kinds came in thick and fast from several sources, so I decided to get down to the root of the trouble and see if it could be corrected. It did not take very long to locate the real cause for all these complaints.

In February, 1904, the C., C., C., & St. L. Ry. made a contract for treating 550,000 ties annually by the creosoting process.

This contract contained the following provision:

> SECTION 7. In the event of ties being shipped to the plant that have not been sufficiently seasoned to permit their being immediately treated and it becomes necessary to stack such ties until they are ready for treatment, all such additional cost is to be borne by the railroad company.

It was represented to the management that such ties as were produced along the lines of the Big Four could be "seasoned," or dried, sufficiently for treatment by leaving them on the right of way, to be picked up later by a work train, and upon arrival at the treating plant could be unloaded directly on to the tram cars, which go into the treating cylinders, thereby avoiding the expense of stacking in the yard. A very plausible theory, but it did not work out in practice, as I will demonstrate to you.

The Big Four commenced to buy treatment ties under this arrangement in June, 1904. Tie producers tributary to the Big Four Railroad were permitted to pile their ties on the right of way, anywhere between stations, and these were inspected in piles by the railroad company's inspector, and later picked up by a work train. The inspection of the ties was done by supervisors of track, track foremen and three regular tie inspectors. The regular tie inspectors were engaged mostly with the inspection of foreign ties, that is ties coming from points not located on the Big Four Lines.

The inspection of ties piled on the right of way proved very unsatisfactory. The work-train service was very irregular, so that a great many ties rotted before they were taken up. It developed that many of the ties produced along the right of way of the Big Four had been "seasoning" for as long as three years; it was also discovered that some of the inspectors who had issued certificates of inspection for tens of thousands of ties, a large proportion of which turned out bad, had left the service, so there was no recourse. The Engineer of Maintenance of Way strenuously objected to my proposition to discontinue inspecting and accepting any more ties in piles along the right of way. but instead to inspect only as loaded on cars at shipping points and ship immediately to the treating plant, where they could be kept under more complete supervision and control and avoid the possibility of damaged timbers reaching the treating plant. He argued that the expense entailed upon the railroad company, namely, 1½ cents per tie, would greatly exceed the loss through deterioration, careless inspection. duplication of inspection certificates and all other losses. The following is an extract of a letter he wrote to me July 14, 1908:

> With our present scheme of taking the ties into our division tie account as quick as they are inspected and making the roadmasters report on the ties which the division takes into its account, or in other words pays for, we do have a check on the inspection.
>
> Probably the best way to get at the proposition is to determine how many ties actually are gotten on the right of way or will be gotten on the right of way. This will represent a certain sum at 1½ cents per tie which we could compare against the probable loss by fire, theft, etc. Offhand my estimate is that on the Big Four we get about 250,000 ties for the Shirley plant on the right of way annually. This would mean, at 1½ cents each, $3,750.00 per year. This sum would equal, say 10,000 ties or about 4 per cent., as I estimate now. I am sure we have not lost 10,000 ties per year or anything near this amount.

Subsequent developments proved that this engineer was badly mistaken. I will explain:

Complaints becoming more numerous and alarming, I resolved, notwithstanding the opposition of this engineer, to change the practice, and, accordingly, in October, 1908, we began taking up by work train the ties that had been inspected and accepted in piles along the right of way. The record of the Engineer's office indicated that we had on hand November 1, 1906, 109,279 ties, scattered over 2,000 miles of road. We commenced with the Cairo Division and cleaned up one division after another. We completed the job in November, 1909. It took us 13 months, notwithstanding we pushed the work as vigorously as possible. The loading by work train was tedious and expensive. It cost the railroad company from 5 to 8 cents per tie to load by work train; when local labor was obtainable the cost was 1½ to 2 cents per tie.

From personal observation I became convinced that it was an erroneous idea to think that a saving could be effected by letting ties remain on the right of way to season and prepare them for treatment. The Big Four was sustaining heavy losses through this practice, by deterioration of ties, careless and bad inspection, duplication of inspection certificates, thefts, fire, claims for culls picked up by the work train, excessive cost for loading work train, bad sorting of ties causing unnecessary labor at the plant, shipping culls along with good ties, to say nothing of the trouble incurred on account of ties being piled promiscuously in ditches, obstructing highways and in many cases piled in almost inaccessible places.

The Engineer of Maintenance of Way argued that by means of his accounting scheme he had a perfect check on the inspection. Evidently he was mistaken, for when the books were audited at the end of the year 1909 it was found that on the St. Louis Division there was a shortage between the Engineer's records and ties actually taken up of 9,167 ties, representing a value of $4,281.88; on the Michigan Division, 3,112, with a value of $1,400.30. The shortages on the other divisions were in the same proportion. Several lots of ties which had been paid for on inspection certificates could not be found.

The method of allowing producers to go ahead and make ties as they pleased and pile them on the right of way for inspection at the railroad company's convenience was another source of trouble, and I will mention only one of many cases. During the years 1905, 1906 and 1907 a Tie Company made a lot of ties and piled them along the right of way on various divisions of the Big Four. By the time the inspectors got around a good many of them were found decayed, particularly the gum and beech ties, consequently they were culled. A good many of these ties were rejected by the inspector on account of other defects and were left on the right of way. It was alleged that a large number

of ties were taken up by the Big Four between January 1, 1905, and December 1, 1907, and used for double tracking, that were never accounted for, although the Tie Company made repeated requests for settlement. In July, 1909, there was presented a bill for $12,770, and upon the refusal of the railroad company to settle the account suit was brought. The case was tried in September, 1913, and a judgment recovered for about $11,000, which was subsequently settled for $9,000. All of this trouble and expense could have been avoided had systematic methods of buying, inspecting and accounting for ties produced along the lines been employed by the Big Four Railroad Company.

In cleaning up the road we found many piles of ties scattered along the line that had been inspected and paid for as long as three years before the work train came around to take them up. They were over-seasoned and so rotten that it was useless to ship them to the plant, so they were left on the right of way, then piled and burned. On one division as many as 10 per cent. were thrown out. An inspector was detailed to reinspect the ties as they were loaded by work train and saw that no worthless ties were loaded and so far as possible sorted them in cars so as to reduce the work at the treating plant. Previously when the ties were loaded by work train without the presence of an inspector a great many rotten and defective ties were shipped to the plant. In fact, 10,680 ties picked up along the right of way were rejected during the year 1907, and 9,312 during the year 1908, upon arrival at the plant. After my method of buying and inspecting treatment ties produced tributary to the Big Four was put into operation, the rejection at the plant was insignificant—only 240 ties were rejected in one year's time—or one tie in 1,000 received at the plant. Work trains to pick up ties at irregular intervals were dispensed with, as the ties were shipped to the plant immediately after inspection and acceptance on cars. All the inspectors under my jurisdiction hailed this new arrangement with delight and reported to me many cases that proved it was an extremely bad practice to inspect treatment ties in piles on the right of way and leave them there to season until they were picked up by a work train. I found that the ties cost no more delivered on cars at stations than on the right of way. The saving in cost of loading by work train, deterioration of ties, losses of various kinds amounted to many times more than the cost of unloading the ties at the plant and piling them for seasoning. My successor has rigidly followed the method, or policy, which I inaugurated on the New York Central Lines.

I concur with Mr. Noyes in his statement that gum and beech ties. produced tributary to a railroad, should be shipped to the treating plant as promptly as possible after being made and seasoned at the plant on line of road. I would include ties of all species of wood.

Although oak and maple do not decay as fast as gum and beech, while seasoning, yet there is considerable deterioration, but the loss through unsystematic methods of accounting, duplication of inspection, losses, etc., is applicable to all kinds of ties intended for treatment.

I trust my experience as related above may be interesting and instructive to the members of our Association.

DISCUSSION ON AIR SEASONING OF CROSS TIES.

By Samuel J. Record.

Mr. Noyes' paper strikes me as being quite sensible and with the exception of one or two minor details I have no criticism to make. It appears to me that it is hardly justifiable to make this paper an excuse for discussing the effect of the season of cutting upon the properties of wood. I fully agree with the general belief that timber cut during the summer is more likely to cause trouble than that cut during the winter. The difference, however, is not, as often claimed, with the wood itself or its moisture content but with the external conditions.

Suppose we ask why milk sours more readily in summer than in winter? One explanation might be that there was a difference in the composition of the milk during the summer which made it more liable to spoil. The real explanation, however, is that during the summer the conditions, particularly the temperature, are much more favorable to the development of souring organisms than during the winter. If milk is placed immediately in cold storage after being taken from the cow it will be found to last fully as long as that taken in the winter.

This reasoning can be applied to wood. During summer when the temperature and moisture conditions are most favorable to the development of fungi it is very evident why wood in exposed places should become infected, and unless naturally durable quickly decay. Ties piled in damp places, as along streams or in situations where the circulation of the air is prevented by rank growth of vegetation or from other causes, are particularly liable to infection. The logical thing to do is to have the ties cut at the season of the year when the destroying agencies are more or less dormant, or if cut during the warm months, that they should be piled in such a way and in such a place that they will dry promptly and not be unduly exposed to infection.

I object to the classification of beech and gum as "softwoods." This term is usually applied to coniferous woods, though sometimes it also includes cottonwood and woods of that sort. To classify beech as a softwood in the first paragraph and to state in the third that beech timber is too hard to hew seems to me a misuse of terms. I also dislike the phrase "while the sap is up," and think it would be better to say

"during the growing season." I have tried to show in various papers that sap does not go up and down as people suppose, and that there is likely to be more water in a tree in late winter or early spring before the leaves put out than during the growing season; and besides it is not a question as to the vital activities of the tree, but merely a matter of external conditions of temperature and moisture, as I have tried to explain.

DISCUSSION ON AIR SEASONING OF CROSS TIES.

By Wm. A. Fisher.

The problems that accompany the handling of beech and the gums are unknown to us, because our line (Atlantic Coast Line R. R. Co.) treats only pine, although we have successfully seasoned a few gum test ties at Gainesville and are now experimenting with others. By "successfully" I mean the ties reached a constant minimum weight without serious checking. The treating of them, however, was a different matter, for they were practically all-heart black and red gum and took only a little over 2 pounds per cubic foot by the same manipulation of the Rueping process that gives pine ties a 5-pound treatment. So we are not so sure the treatment was successful. These gum ties are now in our Gainesville test track.

We conduct our seasoning tests by weighing until a constant weight is reached. At the 1912 Convention I made a report of the result of some preliminary seasoning tests in Central Florida. At that time we were interested only in all-heart longleaf pine, and found that this class of ties seasons in about four months. Continued tests at Gainesville, which is in the north-central part of the peninsula, have confirmed these earlier findings. All cross ties are stacked in the yard in the 8x1 fashion, 100 ties to the stack.

In the last 12 months we have started buying shortleaf and loblolly pine on a "sap-no-objection" basis, as well as longleaf on a specification which allows a minimum of 3 inches of heartwood on each 9-inch face of the tie. We find that about four months is required to season these classes of pine also.

In addition to the above, we are buying and treating sap pine switch ties on the "sap-no-objection" specification, and find that they, too, require four months on the average to reach a constant weight. As is well known the wide ringed pines lose weight very rapidly when first cut. Losses of from 14 to 19 pounds per tie the first two or three weeks are quite common. Case-hardening does not occur with us, for the more or less frequent showers supply enough moisture to prevent this.

Taken the year around we consider our location a good one for the air seasoning of track ties. We have very little sustained humid, cloudy weather or long-continued periods of rain. Though heavy, our rains are generally of short duration, and alternate with bright weather that is almost always accompanied by a breeze. Some of our sap timber has suffered from blue stain, and in a few instances where the ties were cut a long while before delivery to the plant mould has appeared. We are fairly confident, however, that with longer experience we can work out all the problems incident to the proper seasoning of sap pine. With longleaf pine we have never had any trouble.

Fortunately we are nearly free from the dangers which beset perishable ties between the periods of cutting and of delivery at the plant. Practically all of our ties are bought along the right of way from farmers and small dealers who are anxious for their money and who deliver the ties about as fast as they are manufactured. Our specifications require that the ties offered be stacked by what might be termed the "double 8x2" method; that is, two stringers, then a layer of eight crosswise with a second layer of eight immediately on top of the first layer, then two more stringers, and so on. This method was worked out for and gives the best results with our mechanical tie loader, report of which was made at the 1914 Convention. Ties are not taken up unless so stacked, and the result is that a minimum of damage results while the ties are awaiting delivery to the plant, while on the other hand they are seasoning under fairly favorable conditions.

THE PRESIDENT: We will defer the discussion on this paper until we have the report of Committee No. 2 later in the day. I just want to emphasize two points. This advice comes to us from a representative of one of our largest producers, a producer whom, I think, is manufacturing something like 12,000,000 ties a year. It comes to us as a caution and a suggestion of the care with which we should carry on our tie operations so that we do not treat rotten material. We will take a recess now until 2 o'clock, and let me ask you kindly to be back promptly at 2 o'clock, because we are going to have a very important program.

A recess was then taken until 2 o'clock P. M.

WEDNESDAY AFTERNOON SESSION.

January 20.

The convention came to order at 2 o'clock P. M.

THE PRESIDENT: The first thing on the program this afternoon is a paper from a member of our Association, Mr. Emerson, on the subject of "A Method of Finding the Annual Charges for Ties."

MR. HARRINGTON EMERSON: Gentlemen, the time is exceedingly short and a number of very interesting papers are to be presented after this one. I understand the room has to be given up at 5 o'clock. You all have a copy of the paper in your hands. It would be a waste of time to read it. I prefer to use the few minutes that I intend to take in discussing the paper myself.

This formula, this diagram, that has been evolved by my associate, Mr. Bower, that you see in our paper, has two great qualifications. The first one is its extreme simplicity, and the second is that it is correct from the standard practice engineer's point of view. It is so simple that we can figure it in our minds at any time. If anybody asks me quickly the price of a tie in the ground and tells me how many years it is going to last I can instantly tell him how much it is going to cost a year to maintain that tie. If somebody comes along with a proposition for a $3.00 tie, I know right away that a $3.00 tie is going to cost 21 cents a year for interest and taxes, even if it lasted forever, and, therefore, that it cannot be economical.

The second point about the formula is that from the point of view of the standard practice engineer it is correct.

There are three different people who have their say about railroad matters. There is, first, the mathematician or accountant; secondly, the operating man, and thirdly, the standard practice man. The mathematician or the accountant every time wants to put up to you a compound-interest formula. He makes this proposition: You take over a railroad already in existence and you have got to pay $2,400,000 for ties this year. Put them in the track. You must, in addition, set aside a sinking fund so that at the end of 10 years, when those ties are worn out, you will have sufficient money on hand to replace them. As an operating man I would object most strenuously to that proposition, because it involves, in the first place, that you have not only to pay for the replacement of the ties that you are putting into the track, but you have got to accumulate an enormous fund in addition.

On a large railroad using 24,000,000 ties the operating man would not only have to renew all ties but he would have to accumulate a cash fund of $12,000,000 in the course of 10 years. What for? What is he going to do with the fund after he has got it? Why on earth does he need a $12,000,000 fund, and what railroad would stand for charging that $12,000,000 fund to operation? On the other hand, the operating man's theory is that when he has plenty of money to renew the ties he does so, and if he has not enough money then he does not renew as many. He thinks that an allowance should be made for ties on the basis, perhaps, of the number of locomotive miles. How much does it cost to maintain ties per locomotive mile? In 1912 it cost $0.032 per locomotive mile, and the cost is yearly rising. If 6 per cent. interest

and 1 per cent. taxes on cost of ties in track are included, the cost per locomotive mile rises to $0.078. It costs about as much to maintain ties per locomotive mile as it does to maintain the locomotives themselves, and the cost is increasing, so that the problem is one of growing importance all the time. If an allowance of $0.032 per locomotive mile were made for tie renewals if a road had a lot of business tie renewals should be made strenuously; if the road did not have so much business the ties would not wear out so fast, and fewer renewals would be made. The formula helps in making comparisons between one kind of a tie lasting a series of years and some other and different kind of a tie lasting a different length of time. This is the chief gain, the chief utilization that can be made of the formula. Ties cost all the way from $0.05 a year to maintain up to $0.30 a year. I believe at the present time that ties can be maintained on the railroads of the United States for about $0.14 a year apiece, which is less than the average present cost.

In 1912 there were in track 980,000,000 ties; renewals were 116,883,000, or 316 ties per mile, which for that year gives an average life of 8.38 years, although one-quarter of the mileage started with new ties was not yet 8 years old.

If the cost of these ties in track was as low as $0.838, then the annual average renewal cost was:

Interest and taxes	$0.056
Renewal cost	0.100
Total annual cost	$0.156

If the first cost of ties in track is higher than necessary, if any tie is taken out a year too soon, up goes the cost.

A METHOD FOR FINDING THE ANNUAL CHARGES FOR TIES.

By Harrington Emerson and T. T. Bower.

It is evident that some items of investment, like an ocean steamer, drag along through a number of years and then are suddenly scrapped.

It is proper to set up a depreciation reserve from the first year, of so much per year, to charge this assessment as an operating expense and to earn compound interest on the reserve so that at the end of the life of the steamer there will be a sum sufficient to make good the shrink caused by the scrapping. Insurance takes care of total or partial destruction.

Other items of investment do not last for a series of years, then needing replacement, they are used up day by day, like coal and are, therefore, charged out when issued, before use, as an operating expense.

There is no interest charge except straight interest on the amount invested in coal not issued.

Other items, railroad ties, for instance, are so numerous that, like coal, they constitute a constant flow for replenishment. (On one railroad at the rate of 5 every minute). In this case all the ties can be considered as one big tie renewed in part every minute, every hour, every day, the renewal cost thus becoming a monthly charge.

If the ties are worth $25,000,000, 1% for taxes per annum and 6% for interest per annum can be charged monthly against the investment and in addition, there is the monthly charge for replacement, which is the cost of the new ties put in.

This method is both safe and rational on an old road on which the inflow of replacement ties has become continuous.

It is not safe or rational for a new road with 25,000,000 new ties, expected to last 10 years, expected, therefore, all to be gone at the end of 10 years. In this case a sinking fund would have to be set up, sufficient to replace the ties at the end of 10 years. But ties do not wear out in any such regular fashion. Some go in a year, others last 20 years, the renewal is continuous even if irregular. This irregularity vitiates any compound interest plan. If a million new ties are put in during one year and two million the next, the maintenance costs in the second year are the same for taxes and interest, but double for renewals.

Locomotives and cars are also in a state of flow. If a road owned only one locomotive and one car it would have to set up a depreciation assessment chargeable to operation and invested at compound interest for replacement.

When a road owns 1,200 locomotives of which 10 become obsolescent each month, (on basis of 10-year life) then if 10 new locomotives are purchased and the cost charged to operation, no fund is needed and the interest charge runs at simple interest charged monthly on the first cost of the locomotives.

A locomotive does not wear out, it becomes obsolescent. A locomotive 30 years' old can be repaired and made as good as new. It is discarded not because it is worn out, but because it is no longer suited to service. It must, from year to year, either for convenience, be carried at first cost, or for safety, be carried on apraisal at present service value.

We do not pay less for a ticket when the locomotive and the car are 10 years old, than we do with the new car and new locomotive.

If there are many units, if their replacement is charged to operation, they can be safely carried at first cost, provided they are replaced when discarded.

There are, therefore, many ways of determining the value of current equipment:

(1) Its first value until scrapped.

(2) Its replacement value which may be considerably above first cost. Premiums are often paid for early deliveries of earning equipment.

(3) A life-insurance, gradual depreciation plan on the assumption that a locomotive, for instance, of an average life of 10 years and with a scrap value of 20%, is worth 8% less each year for 10 years, and thereafter only scrap value.

(4) A sudden, at the start, reduction to scrap value on the ground that under liquidation it would not bring more.

(5) A writing off of all value on equipment. The General Electric at Schenectady carried $5,000,000 of equipment at $1.00 book value.

(6) A heavy annual reduction so as to wipe out value in two, three or four years. The Fifth Avenue Omnibus Line in New York writes off 33% each year from each omnibus value.

(7) The appraisal method, under which each year the actual equipment is carefully valued. Certain items may be worth more than when new, others although new, have lost all except scrap value. This method, the safest as to items of large value, would show every conceivable variation in values from items five hundred years old worth a thousand times the first cost, to items paid for yesterday and worthless today.

The method of specific reappraisal is not applicable to ties.

The method of writing off total first cost applies no more to ties than to grade or rails or buildings.

The assumption that all ties may average half value applies equally to everything else on a railroad and would justify a claim for lower rates because of lessened investment value. This method would not appeal just now to railroad directors.

A tie is good, a rail is good, until taken out and, on an old road, if operated, can be safely carried at full first cost.

These different methods are outlined in the diagram.

As to ties, we assume they are worth what they cost to put in until they are taken out, then losing all value suddenly.

This assumption makes the whole computation very simple so that any comparative proposition can at once be solved.

To determine the annual cost of maintaining any tie all we need to know is:

(a) First cost in track.

(b) Annual interest and tax rate.

(c) Life of tie.

The first cost of the tie consists of three main charges, some of which may be still further subdivided. The three main charges are:

(1) First or wood cost of tie, including foreign freight, preservatives and mechanical protection.

(2) Labor and other costs of putting ties in the track.

(3) Overhead supervising charge.

The sum of these is the cost of the tie in track.

On the first cost of the tie there is a tax charge and an interest charge. In our calculations we assume a tax rate of 1% on value and an interest rate of 6%, making a total of 7%. Any other rate can be used.

The annual maintenance charge for all ties is the sum of annual interest and tax on first cost of all ties in track and of the replacement cost in track of all ties removed.

Over a series of years the replacement accurately determines the average life of all ties. If one-tenth of all the ties is replaced each year the average life is running at the rate of 10 years. If one-twelfth is replaced the average life is running at the rate of 12 years. If one-eighth is replaced, the average life is running at the rate of eight years. If in 10 years as many ties have been replaced as the total in service, the average life is 10 years, irrespective of variations in different years.

The annual maintenance cost can be expressed by the formula:

$$A=\frac{C}{Y}+C(i+t)$$

A=Annual maintenance charge.
C=First cost of tie in track.
Y=Average years of life determined by number of removals.
i=Rate of interest on investment.
t=Tax rate on investment.

By means of the above formula the accompanying diagram has been constructed for solving instantly as to a single tie or classes of ties, all ties for a year or series of years, the fundamental question of the relation existing between:

(a) First cost of tie.

(b) Life of tie.

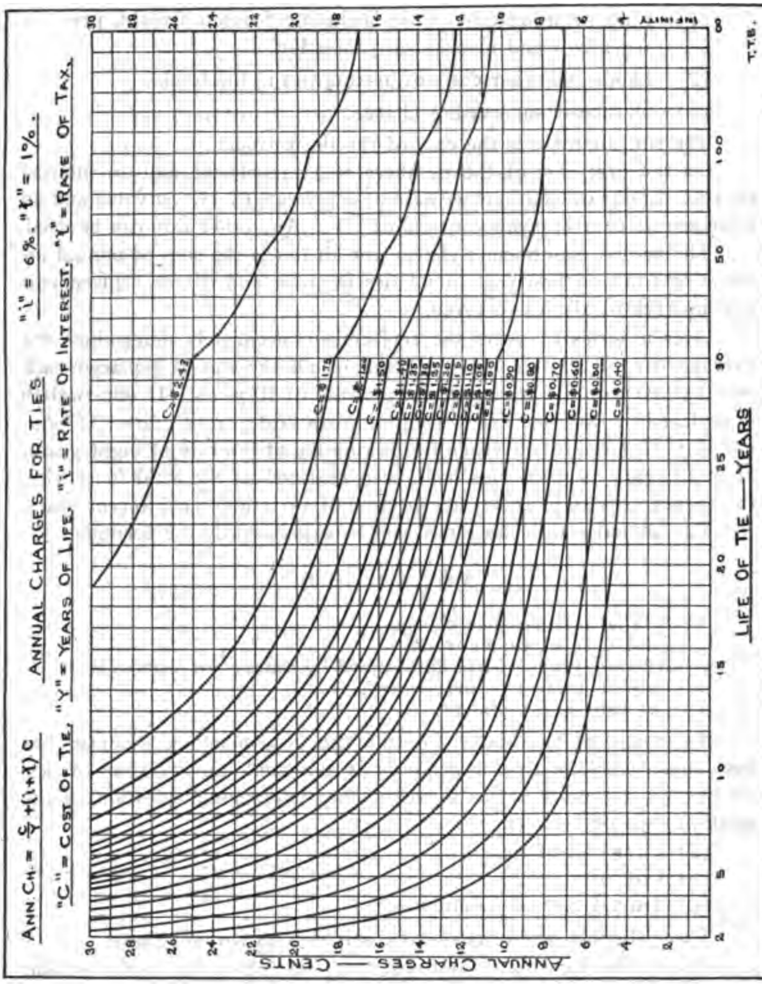
(c) Annual cost of maintenance.

Three distinct problems may be solved with this diagram:

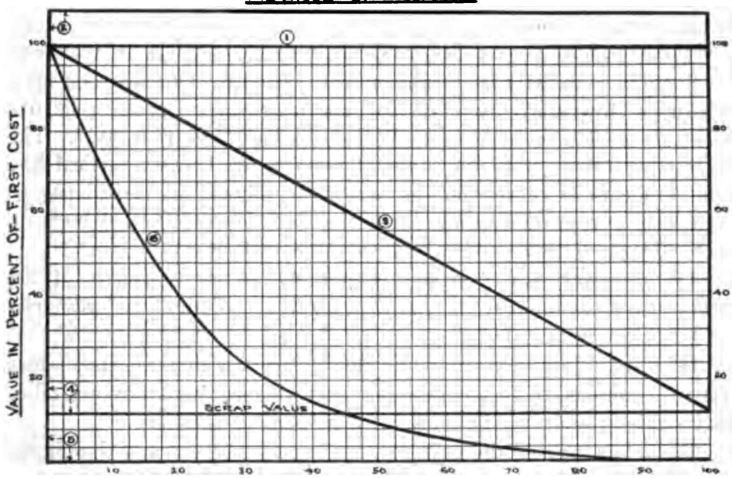
Fixed annual cost with first cost and duration of life, both variable.

To illustrate:

Take the horizontal $0.15 line of annual charge as the standard annual cost. Along this line there are numerous intersections with the curved lines of first cost and the vertical lines of duration. Therefore,


ANN. CH. = C/Y + (i + t) C
ANNUAL CHARGES FOR TIES
"i" = 6%, "t" = 1%.
"C" = COST OF TIE, "Y" = YEARS OF LIFE, "i" = RATE OF INTEREST, "t" = RATE OF TAX.
LIFE OF TIE — YEARS
ANNUAL CHARGES — CENTS
T.T.B.

METHODS OF VALUATION



if ties are kept up on an allowance of $0.15 per tie per annum, there are many solutions as follows:

First Cost.	Duration.	Annual Cost Per Tie.
$0.40	3.2 Yrs.	$0.15
$0.60	5.5 Yrs.	$0.15
$0.75	7.6 Yrs.	$0.15
$1.00	12.5 Yrs.	$0.15
$1.25	20.0 Yrs.	$0.15

But we may take another problem, namely that of first cost fixed, but annual cost and time variable.

First Cost.	Duration.	Annual Cost Per Tie.
$1.00	2 Yrs.	$0.57
$1.00	3 Yrs.	$0.403
$1.00	4 Yrs.	$0.32
$1.00	5 Yrs.	$0.27.

First cost, $1.00; 2 years duration.

Interest	$0.07
Annual cost	0.50
Total	$0.57

Finally, we can assume an average standard life, say 15 years, and determine first cost and annual costs.

First Cost.	Duration.	Annual Cost Per Tie.
$0.40	15 Yrs.	$0.0546
$0.60	15 Yrs.	$0.0820
$0.75	15 Yrs.	$0.1025
$1.00	15 Yrs.	$0.1366

The first illustration given here, that of fixed annual cost with varying duration and first cost, is by far the most valuable of the three. This solves definitely the economic question of the value of tie treatment.

Suppose a tie without treatment costs $1.00 in the track and lasts 10 years. How much may be spent for treatment to prolong its life to 18 years? The annual cost of $1.00 tie lasting 10 years is $0.17. The intersection of the $0.17 horizontal line with the 18-year vertical line falls on the $1.35 curved line of first cost. Therefore, it will pay to spend $0.35 for chemical treatment or mechanical protection, or both, on the $1.00 tie to prolong its life from 10 years to 18 years.

The diagram also illustrates graphically, by the steepness of the curves, the great economy in prolonging the life of ties that ordinarily last but a few years.

It is, of course, understood in this theoretical diagram and tables that tie maintenance is a continuous performance; that nothing takes place suddenly and that there are great individual variations.

The advantage of the cost formula used is its extreme simplicity. The conclusions it forces on us are, however, not invalidated by any other formula, however complex.

Annual maintenance is cheap when good ties cost little and when they last many years. This was the condition 20 years ago. White oak ties cost in certain regions as little as $0.20; the standard rails were about 60 lbs., the axle loads about 15,000, the cars with only 40,000 lbs. capacity, trains comparatively few. Ties were rarely rail-cut and lasted indefinitely. The annual cost of a $0.20 tie ($0.40 in track) lasting 20 years, was $0.048 per year.

Now inferior woods cost more than best white oak formerly did, axle loads have increased, car loads have increased, trains are more frequent and heavier. It is a race between fungus and rail to see which will destroy the tie sooner. A good tie in main track costs at least $1.00 and, unless treated, wears out in seven years. Annual cost $0.213. At this rate it would cost a road with 25,000,000 $4,000,000 a year more than it did 20 years ago. Creosote, at a cost of $0.25, put on heavy tie plates at a cost of $0.35 more, and the first cost rises to $1.60. Such a tie, would have to last 16 years to give a yearly cost of $0,213. Will it? Assume that it lasts 10 years, the annual cost becomes $0.273. This is $5,500,000 a year more than it was about 1905.

There is at present no immediate prospect of any economical substitute. In 1904, at St. Louis, I was shown a cast-iron tie, which the patentee thought could be made for $3.50. The interest and tax charges alone on this tie would be $0.245. Assuming the tie to last 30 years and to have a scrap value of $1.00, the tie would cost $0.328 to maintain. There is still nothing fulfilling the purpose as cheap as a good wood tie.

It is at present unreasonable to consider any substitute, even with a certain life of 20 years at a higher cost than \$1.67, since \$0.20 a year is sufficient to maintain best main-line ties.

Tie expense is reduced to a minimum by five rules:

Buy the ties carefully.
Spend all on protection that the gain in life justifies.
Use them at once.
Do not take them out before they are used up.
Assort them for proper use.

Careful buying insures a price reduction of about 10% and a quality increase of about 20%.

To allow ties to lie fallow for two years shortens the life two years and adds about \$0.14 to first cost.

Many ties are removed from one to five years before they are really gone.

A new, rotten tie costing to lay in track \$0.80 and lasting two years, costs per year \$0.456, or more than twice as much as the maintenance of the best main track tie, plated and preserved.

THE PRESIDENT: We are highly pleased to have this contribution to our program, and I can say for myself that I am, indeed, sorry I have not had the opportunity to give this matter the study that it deserves. Mr. Emerson's paper did not reach my office before I left for the convention, and I am satisfied it did not reach a great many others. We have, however, one or two discussions, and we have with us one or two gentlemen in official capacity of our prominent railroads, and while they are not members they are deeply interested in the subject, and the first paper I am going to ask to have read is one from Mr. Hendricks of the 'Frisco. I am going to ask if I cannot impose upon Mr. Finley, of the Northwestern, to give us a few remarks on this subject, because it is certainly a deeply interesting one to all of us.

DISCUSSION ON A METHOD FOR FINDING THE ANNUAL CHARGES FOR TIES.

By V. K. Hendricks.

The authors are not clear and conclusive in their arguments against the use of compound instead of simple interest when comparing the economy to be gained by the use of various kinds of ties. If, as they state, "this irregularity (in the life of individual ties) vitiates any compound interest plan," it would seem that such irregularity would

also vitiate comparison of the economies to be gained by the use of different kinds of ties. We all know that this great irregularity exists, but in order to make a comparison of any kind it is necessary to determine as closely as possible the average life of the particular kind of tie under consideration and base the comparisons on that average life. The fact that this irregularity exists does not make it proper to use simple instead of compound interest in comparing the economies to be gained.

The assumption that all ties may average half value does not apply equally to everything else on a railroad, as there are some important items in a railroad property which appreciate instead of depreciate, and the fact remains that, when considering the cross ties only and not considering any other items entering into the railroad property, a railroad which had all ties new would be worth more than the otherwise identical railroad with the average life of all of its ties half gone, or with its ties all in such condition that the same number would have to be renewed each year commencing at once.

In the case of the railroad with all new ties, no expenditure for renewals would have to be made for several years, and the cost of such renewals, when required, discounted to the present time would be a smaller amount than would be the cost of renewals in the other two cases discounted to present date.

The assumption that ties are worth what they cost to put in until they are taken out, then losing all value suddenly, is a theoretically incorrect assumption, and would only be justified as a "trade" or compromise for omitting other items which should properly be taken into consideration. The question of railroad valuation is not up for discussion, but it may be stated here that development cost of a railroad and appreciation of right of way and roadbed would far more than make up for the depreciation of the perishable properties.

Every dollar is capable of earning compound interest, and compound interest should be used for the correct calculation of cross-tie economies instead of simple interest, or the results in extreme cases may be misleading. The question of whether the cost of cross-tie renewals is assigned to the Maintenance Account or to the Construction Account would make no difference in the proper method of calculation of the relative merits of the various ties.

If we assume that, since cross-tie renewals are now considered as a maintenance expense, they should still be considered as a maintenance expense, even though we make such renewals in more expensive ties, the fact would remain that we would have to provide additional money for the excess cost of the new kind of ties and, as compared with the maintenance cost with the old ties, we would have to do what would be equivalent to paying interest on the excess cost and interest on the

interest on such excess cost which, as a result, would be compound interest on the additional cost. By allowing compound interest on the additional cost the result would be exactly the same as though compound interest had been used throughout the entire calculation.

Let us assume that there are two railroads which are absolutely identical in every way, and that all renewals are perfectly normal; that is, that the expenditure is the same each year for each class of renewals, and further, that each road has $1,000,000 surplus funds annually which can be applied as it sees fit. Assuming that the normal tie renewals cost $1,000,000 per year and that one of the roads decides to use a more economical kind of tie than the other, which practice requires the extra $1,000,000 of its funds, allowing all other expenditures to remain the same as in the case of the other road, the second road could invest its $1,000,000 and could invest the interest paid on the $1,000,000, which would be the same as receiving compound interest on the $1,000,000 surplus. If, therefore, the first road had based its calculation of cross-tie economy on simple interest instead of compound interest it would not be getting as much out of its investment in improved ties as the second road would be getting from its investment of the $1,000,000, and the first road's investment should not be considered a good financial proposition.

As a matter of information, taxes in many of the States are not based on the physical value of railroad property, but on the earning power of the railroad. Whether this basis is correct in the case of a regulated public service corporation or not is not suitable for discussion at this time, and in any event the allowance of 1 per cent. for taxes would merely be equivalent to changing the percentage used in the calculations.

THE PRESIDENT: I will ask Mr. Finley, of the Northwestern, to say a few words on this subject.

MR. W. H. FINLEY: Mr. Chairman, I regret that I am not prepared to discuss the paper. I did not get it in time to give it the attention such a paper warrants. I did not expect to be able to attend this meeting.

THE PRESIDENT: We are delighted to have Mr. Finley with us, and possibly would like to have him submit a written discussion on this paper at a later date.

MR. W. H. FINLEY: I would be glad to do that.

THE PRESIDENT: Are there any other remarks on this paper?

MR. W. F. GOLTRA: The formula which Mr. Emerson has proposed for ascertaining the annual maintenance cost of cross ties is

different from that which has been generally accepted. In my opinion his formula is incorrect, for the reason that it is based on simple interest on the initial cost of tie in the track for each and every year of its life, whereas only that diminishing portion of the initial cost remaining after each year should be taken and figured at compound interest.

In estimating the relative cost of economy of different ties, it is common to divide the first cost of the tie, in the track, by the number of years' service which it may be expected to give, and call the quotient the annual maintenance cost. This is not correct and may lead to erroneous conclusions. The interest charge should be taken into account. The main point of difference in opinion between Mr. Emerson and myself is the method of calculating the interest. The proper way. in my opinion, to ascertain the annual maintenance cost is to calculate what amount of money is necessary to pay each year into a sinking fund to equal the cost of renewing the tie in the track when it has outlived its usefulness.

The formula generally accepted for determining the annual maintenance cost of ties is as follows:

$$A=C\frac{1.0i^{y}\,0.0i}{1.0i^{y}-1} \quad \text{in which}$$

A = Annual maintenance charge.
C = Initial expenditure, or cost of tie in track.
y = Average life of tie, or years of recurring period.
i = Rate of interest, including taxes.

This formula is more complex than Mr. Emerson's, but it is the correct way of determining the annual charge. It is simple after one understands it. In explanation let us take Mr. Emerson's example and substitute the following values in the above formula:

$$C=\$1.00,\ y=10 \text{ years and } i=7 \text{ per cent.}$$

We have

$$A=1.00 \times \frac{(1.07 \times 1.07)^{10} \times 0.07}{(1.07 \times 1.07)^{10}-1}$$

The figures in parentheses should be multiplied so as to raise the product to the tenth power. Of course, it would be a tedious and laborious job to figure each and every problem, but there are printed tables available which give the values for all combinations. These are called Tables of Annuities, and from them one can obtain readily the annual charges for any combinations, like an insurance agent can quote the annual premium for any kind of policy based upon the age of an applicant for insurance.

Working out the above example we find the annual charge is $0.143 instead of $0.17, when figured Mr. Emerson's way. The interest

at 7 per cent. on a tie that costs $1.00 in the track and lasts 10 years is $0.43 and not $0.70. It is not customary to take taxes separately into account; these are generally included in the interest rate that may be assumed. However, as Mr. Emerson adds them together, it amounts to the same thing.

I think the interest rate assumed by Mr. Emerson is too high. It is usually assumed at 5 per cent. If the above example was figured on a 5 per cent. basis, according to the accepted formula, the annual maintenance charge would be $0.13 a year—$0.10 for the tie proper and $0.03 for the interest.

The diagram presented by Mr. Emerson, which represents the values calculated by his formula, is interesting, but I think the correct values for any combination can be obtained more readily and more accurately from printed tables, besides the tables have a much wider range and can be utilized to calculate the relative economy of treated and untreated telegraph poles and fence posts, as well as cross ties. For example, the table gives values for—

A life (y) from one to fifty years,
Cost in place (C) for any sum expended,
Interest (i) at 4, 5, 6 and 7 per cent.

By assuming numerical values for each of these factors the annual cost of maintenance is readily and accurately computed from these tables.

THE PRESIDENT: Are there any further remarks on this paper?

MR. C. P. WINSLOW: Mr. President, I would like to take the time of the meeting for a few moments. The problem under discussion is one which has interested me for some time, and I wish to make it entirely clear that the object of my remarks is primarily to bring out certain phases of the question which seem to me important and on which I am seeking further enlightenment. It appears to me that there are two rather distinct aspects of the problem; one dealing with the most theoretically correct method and the other with the practicability of applying it in accordance with the exigencies of the situation and the methods of accounting which may be in use by a given company.

In connection with the first aspect I took occasion to determine what the annual cost would be, using the compound-interest method and the method advocated by Mr. Emerson. With a tie costing $1.00 in place in the track and having a life of 8 years, on the compound-interest method I think the annual cost amounted to about $0.14, while by the other method it amounted to about $0.165, making a difference of $0.025 per year between the two methods. In eight years this difference would amount to $0.20, or 20 per cent. of the total cost, which

is quite a considerable difference in the result, according to the method used. To compare the two methods on another basis, I assumed the condition of an untreated tie, costing $1.00 in place in the track, with a life of 8 years, and of a tie heavily treated with creosote and equipped with heavy tie plates, screw spikes, etc., and costing $1.50 in place in the track. To secure the same annual charges with the untreated and treated ties, it would be necessary for the treated tie to last a little over 16 years, if figured by the method proposed by Mr. Emerson, as compared to only 14 years if figured on the compound-interest basis. In other words, under a condition where untreated ties were being used and the question arose as to the use of certain kinds of treated ties at a greater initial expense, in order to show an economy by the use of the treated tie a longer life would be required if Mr. Emerson's method were used instead of the compound-interest method. On the figures I used it amounted approximately to an 18 per cent. longer life, and I think this is sufficient to justify a careful consideration of the two methods.

A further point that impressed me is in regard to a railroad which is under construction. I fail to see just how the method proposed by Mr. Emerson would apply under those conditions. A road may be building over a period of years. Annually a certain amount of track is being built and a certain amount of this expense is going into ties. Presumably this expense is being paid from the capital account. To go along for a period of, let us say, from 5 to 7 years with no charges for tie replacements or renewals would, I think, tend to give an erroneous impression of operating expenses which, on this basis, would apparently suddenly increase after 6 or 7 years when it became necessary to replace the ties first laid. On the other hand, the compound-interest method would apply as soon as the ties were laid, and annually a certain sum would be put aside and after 6 or 7 years when the road was completely built and the ties first installed were ready for renewal there would be money to renew them, this maintenance cost having been distributed over those years when the ties were actually depreciating.

In regard to the practicability of adopting or applying the compound-interest method, I can only say that I am entirely open to enlightenment on this point, and regret that I have not had an opportunity of studying this phase of the matter as well as Mr. Emerson's entire paper with anything like the detail I would like to and plan to in the future. I only offer the foregoing as some comments which might be worthy of your consideration. Thank you.

THE PRESIDENT: Mr. Emerson, have you a few remarks that you would like to make in reply in closing the discussion?

MR. HARRINGTON EMERSON: The written and verbal discussions of Mr. Bower's and my paper bring out interesting differences of opinion as to every assumption we made. Many critics object to our rejection of the old formula based on compound interest. We had a discussion which lasted several months in our own office on this compound-interest theory and, after hearing all the arguments, came to the conclusion that it rested for support on the following assumptions:

(1) That a railroad company owns one enormous tie.
(2) That this tie is worth millions of dollars (on our road $24,000,000).
(3) That this tie suddenly wears out and has to be replaced.
(4) That this replacement occurs at the end of a number of years (6 to 20).
(5) That the cost of replacement is so sudden and so great that almost any road would be bankrupted by it unless through the years a replacement fund had been gradually, year by year, accumulated.

If these assumptions are true, then, of course, the compound investment of an annual assessment is the only safe plan. Unfortunately for the compound-interest advocates every one of these assumptions rests on imagination and not on fact.

The railroad we were studying did not own a single big tie, analogous to a big bridge, but it had in track 24,000,000 ties. These 24,000,000 ties do not suddenly wear out, but, like the particles of our dead skin we wash off daily, were in a process of passing away continuously. Whoever heard of setting up a reserve to renew one's skin? The replacement did not occur at the end of a long period, but ties on a long average were being renewed at the rate of one every 13 seconds. The cost of replacement is not sudden, but is as continuous as the air we breathe in and out and nobody would set up a reserve fund to buy at long intervals a tank full of oxygen.

Coming down to a practical question, is there any railroad in the country that has set up at compound interest an assessment fund for tie renewals?

If there were such a plan in operation, would there ever be any money in it? Would we be justified in making such a fund larger than sufficient to take care of tie renewals? And if renewals occur at the rate of five a minute when would there ever be any reserve? If passengers pass out of the local subway stations as fast as the trains unload them, have we any need at these local stations for vast concourses big enough to hold 100,000 people? Not much.

If a railroad with 24,000,000 ties charged to renewal expense every month $200,000 and put in a dollar tie every 13 seconds, how much money would remain to draw interest at the month's end?

If the month were January the expenses would amount to $206,000 If the month were February they would amount to $185,000.

What really happens to a railroad is that during its first years tie maintenance is not so heavy as at the end of 20 years, and it is lucky that it is not, for revenues are also not so heavy. Nevertheless, tie re-

newals do begin from the first month, just as out of 10,000 persons born in January, 1915, some die at once.

The idiosyncrasies of engineers, or of revenues or of the tie market, or of traffic, have more influence on tie life than straight decay or wear. We may, therefore, dismiss the compound-interest formula as having no practical application to ties.

Another question was, however, raised to justify an accumulation. The argument runs:

A railroad has 24,000,000 ties in track which cost $24,000,000, but as they are half worn out they are only worth $12,000,000, and a sinking fund of $12,000,000 ought to exist to make good the shrinkage in the value of the bonds or stock.

If this point of view were correct, all rolling equipment, all ties, rails, bridges, station and terminal buildings ought to be depreciated one-half, since all these are also half worn out. As an offset the roads would have only those appreciations in fortunate purchases of real estate at terminals.

Under this argument a new road just started without as yet any revenue is worth more than a road twenty years old with revenues paying all operating expenses and yielding 10 per cent. on a total, undepreciated investment.

A belt, a machine, a tie, a rail, a locomotive, a car, a bridge is second hand even if not worn, and scarcely worth half of cost, if the company to which it belongs ceases to operate. The tunnels, cuts, fills, etc., lose all value.

A maintained and renewed operating concern is always worth its first cost and more if it pays normal dividends and absolutely without reference to scrapped or dismantled value or first cost it is worth what its dividends make it.

The shares of the $50,000,000 of water or good will issued by the Woolworth Company, even in these times of low values, are quoted at $90.00 each. As a going concern the Rumely Company paid on a basis of cost valuations $10,000,000 on preferred shares, $10,000,000 on common for various prosperous plants and borrowed $10,000,000 on short-time notes for inventories and manufactured material. When it was doing a business of $18,000,000 all these securities stood at par or above. The same plants and equipment are there today, but the preferred is quoted at 5¾ and the common at 1⅝, a shrink of over 94 per cent. in three years. Sinking funds do not avail in case of shipwrecks and slowly accumulating sinking funds are not needed by going concerns.

Objection was also made to charging ties with interest on their cost as an annual charge and particularly to charging as high an interest rate as 6 per cent. Would not a railroad company gain if it

could lease ties instead of buying them, even as it leases Pullman Cars? It would not have to invest so much money at the start. Also the ties would receive better care because the tie-leasing company would concentrate all the wisdom available in the world on ties and their preservatives.

If a railroad leased its ties it would have to pay as rent the interest on their cost in the ground. Can any railroad borrow money for 6 per cent. or less? If not, 6 per cent. is a reasonable rate of interest. If a railroad can borrow money at 4 per cent., then, of course, it ought not to charge ties with more than 4 per cent.

It has been objected that taxes are charged on capital stock, not on property. It has been my experience that most tax-levying bodies try to tax both capital stock and the assets in which the capital is invested. However, this makes no practical difference. If a railroad owns $100,000,000 of tangible property in equipment and road and is taxed $1,000,000, the tax amounts to 1 per cent., even if the capital is $200,000,000 and the levy is 0.5 per cent.

On the basis of the value of the ties railroads are taxed about 1 per cent.

Therefore, on the basis of 6 per cent. interest and 1 per cent. for taxes, the diagram is useful for those roads that charge tie maintenance as an operating cost and have not in the long years of the past accumulated an endowment fund whose income takes care of tie renewals.

THE PRESIDENT: As I said before we highly appreciate this important discussion, because it affects such a large percentage of the expense of operating a railroad. A few of us little realize what a large proportion of our operating cost is chargeable to ties. I happened in the last few months to get together the relative cost of rail and ties on our particular railroad, and when I tell you for the year 1914 the cost of ties was just four times the cost of rail you will readily realize what this item means. We are glad indeed to have this discussion, and I am only sorry that we have not more time to give to this paper, but we are getting behind on the program and I am going to ask Mr. Sterling if he will not preside for a few minutes and continue the program.

(Mr. E. A. Sterling then took the Chair.)

CHAIRMAN STERLING: I understand that the matter recently under discussion is now closed, so we will proceed with the program and call on Mr. Stimson for the next paper, which is on "The Mechanical Life of Ties as Affected by Ballast."

MR. EARL STIMSON: In order to save time it has been suggested by the Secretary that, inasmuch, as the paper has been distributed and we therefore have a right to assume that everybody

has read it very carefully and understands all about it, the reading of the paper be dispensed with. The conclusion reached in this paper is that ballast has comparatively little direct effect on the mechanical life of the ties. The effect of the ballast is indirect. It attacks the tie in two places: First, on the top of the tie where the fine, gritty particles of gravel, granulated slag, cinder or similar ballast collect beneath the base of the rail, increasing the abrasive action of the rail against the top of the tie and greatly accelerating the wearing out of the tie from rail cutting. Second, on the sides and bottom of the tie, where the hard forms of ballast, such as crushed stone and hard slag, wear the tie to some extent by the tie working in the ballast under load and to a greater extent by being tamped solidly against the sides and bottom of the tie. The lower edges of the tie are also somewhat worn away by contact with ill-directed blows of the tamping bar or pick. A good, substantial, well-drained roadbed is recommended as the best means of overcoming excessive tamping of the ballast in and around the ties, which apparently is the chief cause of the mechanical wearing away of the ties by the ballast. A hard, clean stone ballast is recommended as the means of minimizing the abrasive action of the rail against the top of the ties.

THE MECHANICAL LIFE OF TIES AS AFFECTED BY BALLAST.

By E. Stimson.

The wooden cross tie, transmitting the heavy axle loads from the rail to the ballast is subjected to mechanical wear not only from the action of the rail on top of the tie, but also from the action on the sides and bottom of the tie of the ballast which supports it.

The most familiar causes of the deterioration which makes necessary the removal of the ties from the track are, decay, splitting, mechanical wear under the rail, spike killing, burning due to dropping coals from locomotives and damage by wrecks. While the influence of these factors is felt on all classes of track from isolated sidings to the highest type of main track, tie destruction from mechanical wear of ballast seldom occurs to any appreciable extent excepting in occasional stretches of crushed stone, or other forms of hard ballasted tracks where a soft roadbed or a sink requires continual raising of track and tamping of ties in order to maintain good track surface. The wearing away of ties by ballast, is the result of tamping the ballast under the tie and the action of the tamping tool striking the side and edge of the tie rather than the action of the tie bearing upon and working in the ballast under train loads. There is but little mechanical wear due to the tie working in the ballast.

After ties are first put into the track and tamped to surface on hard ballast, the necessity for retamping to surface and consequently the wear of the ties by ballast depends largely upon the nature of the sub-grade. Good surface and sub-surface drainage usually insures solid road bed where the normal bearing value of the material qualifies it for heavy loading. Where such conditions prevail, track surface is maintained with a minimum amount of tamping and the mechanical effect of the ballast on the ties is negligible. Wet cuts and fills, road-bed sinks and side hill slips produce conditions for which the track as a whole suffers. They are responsible in the majority of cases for bad surface and alignment and can therefore, be said to be the underlying cause of tie deterioration from mechanical wear of ballast. Such conditions are usually local and limited in their extent over any stretch of track and the total mileage of roadway involved composes only a small percentage of the total roadway of any railroad system. The removal of the cause, and the restoration of the stability of the roadway, in many cases involve heavy expense, for which reason the conditions are often allowed to remain, making necessary the continual employment of forces raising the track and tamping the ties to surface. Thus the roadway conditions are responsible for the excessive tamping and wearing away of the ties. As this does not involve a relatively large number of ties, and as usually the prevention is often difficult and expensive, to some extent, this excessive track maintenance and consequent tie wear from ballast will inevitably exist as long as wooden ties are used.

Ties which are removed after service in hard ballasted track are found to be pitted or indented on the bottom and sides from contact with the stone or other ballast material as illustrated in photos No. 1 and No. 2. These indentations in the tie are a valuable factor in holding the track in line and surface as long as they are not increased by frequent tamping. The continual tamping of the ballast under the tie soon rounds off the edges of the ties leaving little or no flat bearing surface for support. When this happens the tie acts as a wedge and tends to force the ballast out into the cribs instead of receiving full support from it. This is illustrated in Figure No. 1. It typifies the worst conditions, however, a tie seldom becomes rounded to this extent throughout its entire length. Photos. No. 3 and No. 4 show open cribs and the worn edge of ties inside and outside of the rail. It is to be noted that the greatest wear occurs from 6 to 8 inches either side of the rail and practically none directly under the rail. In track maintenance the best practice is to tamp the tie for its full bearing upon the ballast outside of the rail and for an equal distance inside of the rail. In spite of close supervision, however, this is not always done but instead, the trackman expends his efforts toward tamping up solid as near

Photo. No. 1.

Photo. No. 2.
Yellow pine ties after six years' service showing the extent of inundation of stone ballast.

Photo. No. 3.

Photo. No. 4.
Black walnut tie after three years' service on a sink in a 15-ft. fill showing the wear on the bottom edge due to tamping stone ballast on an average of three times per week.

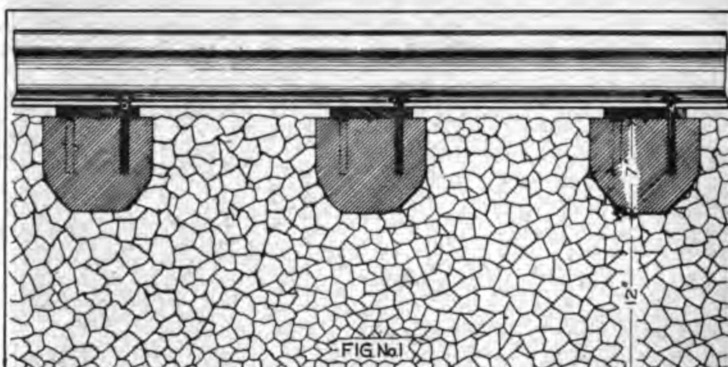
Photo. No. 5.
Pine tie three years old on a sink in stone-ballasted track showing the effect of frequent tamping.

Photo. No. 6.
Pine tie removed from track after six years' service in stone ballast on account of decay and mechanical wear under the rail. Note the wear on the bottom due to tamping. This tie was located on solid road-bed and received only the average maintenance for first-class track.

Photo. No. 7.
Yellow pine tie three years old on stone ballast.

Photo. No. 8.
Showing limits of wear along bottom edge of tie each side of the rail seat.

Photo. No. 9.
Tie badly rail-cut in a fine gravel ballast.



Section through tie at edge of rail flange showing how the bottom edge becomes rounded off due to excessive tamping of ballast.—Tamping around bottom tie forces the ballast in to the cribs making it difficult to pack solid under the tie.—

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Photo. No. 10.
Tie badly rail-cut. Cinder-ballast worked under rail, increasing wear.

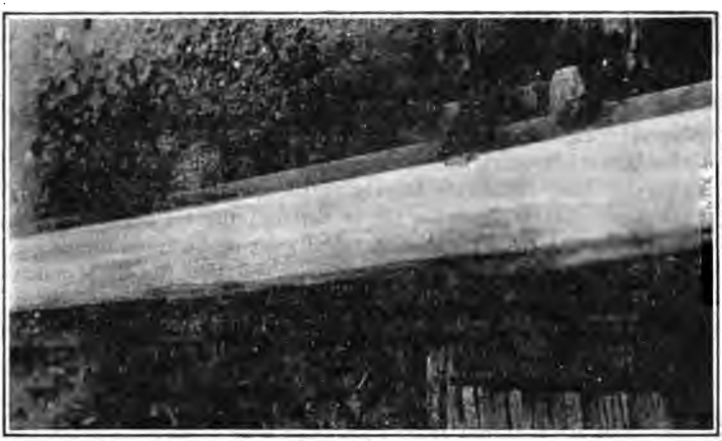


Photo. No. 11.
Same condition as shown in Photo. No. 10, with tie plate.

the rail as he can work with a tamping pick. This wears off the edge of the tie for some distance each side of the rail and leaves a short unworn edge directly under the rail. When a tie becomes rounded on the bottom at the most essential tamping point and becomes difficult to maintain to surface, it is then found more economical to replace it with a new tie having a flat bottom that will necessitate less tamping. The average trackman feels little hesitancy about removing a tie for this cause when he has difficulty in keeping it tamped. Even in cases of most excessive tamping, wear from ballast does not become objectionable until the tie has been in service from 50 to 75 per cent. of what its life would be under normal conditions. The kind of ballast and kind of ties used and the standard at which a track is maintained, are all important factors in the consideration. Slag and stone when crushed, form hard, sharp, angular fragments that appear, from observation, to be more destructive when tamped under wooden ties than gravel, burnt clay, cinders, granulated slag or other similar forms of ballast. Ballast of the last named materials has little or no effect in wearing down the sides and bottom of the ties nor is the tamping of this kind of ballast so destructive to the ties, as the particles are smaller, generally of softer material and rounded in form. There is a perceptible difference in the resistance offered against mechanical wear by ties made from the different kinds of wood. Hard wood ties of tough texture withstand the action of the rail cutting and of excessive tamping much longer than ties of soft wood. It has been observed that these ties which are most durable under the mechanical wear of the rail also last longer under the wear of ballast, for instance—white oak, chestnut oak, black walnut, maple and beech are more suitable than yellow pine, fir, catalpa, cedar and red wood.

Here it is important to mention the extent to which some forms of ballast increases the abrasive action of the rail upon the tie. Granulated slag, gravel, cinders, chatts and other forms of ballast carrying fine gritty particles contribute largely to the rapidity of the abrasive action between the rail and the tie or between the tie plate and the tie thus greatly accelerating the mechanical wearing away of the wood. It has been observed that the cutting of the rail into the tie is much greater where fine ballast is used than where coarse hard ballast is used. This trouble has been largely overcome by use of flanged bottom plates which become embedded in the tie, and by plates fastened directly to the tie by lag screws, independent of the rail spiking, thus reducing the movement between the plate and tie to a minimum However, many ties are removed from track each year because of deterioration from rail wear and a large amount of this deterioration can be assigned to the effect of the fine particles of ballast grinding under the rail (See Photos. 9, 10 and 11).

A careful study of the wearing effect of ballast upon ties during tie removal seasons where the actual cause of deterioration under roadbed and track conditions can plainly be seen, is convincing evidence that such wear along the bottom edge only injures the ties where tamping is necessary at quite frequent intervals.

Regarding the use of treated ties where extraordinary wear by ballast is known to exist; the same rule might apply that is observed when the mechanical wear under the rail limits the life of the tie. Treatment to prevent decay does not give the tie increased resistance to abrasion, and ballast abrasion that is so severe as to wear out an untreated tie would preclude the possibility of any benefit from the use of treated ties at locations where such abrasion occurs.

In conclusion it might be said that the ballast has little direct effect on the mechanical life of the ties. The finer and lighter ballasts such as gravel, cinders, granulated slag, etc., hasten the rail cutting on the top of the tie by the finer particles working under the rail. The coarser and heavier ballasts, such as, crushed stone and slag bruise and cut into the bottom and the sides of the ties largely under tamping. Comparatively few ties are destroyed from this latter cause, while many more are removed from track on account of the former.

A substantial, well-drained roadbed, and a clean, hard ballast, free from fine particles and coarse enough to insure against holding water, affords the best foundation for the tie, one that will hold to a minimum the "Wave Motion" of the rail which, aided by the abrasive agent, the fine gritty ballast, so rapidly cuts into the ties, and one that will hold the surface of the track, eliminate the "Sinks" and "Slides," "Pumping Joints" with the attendant "Pounding" of the ties into the ballast, and lastly the excessive "Tamping Up."

The desired roadbed condition must usually be made with the materials available, aided by tiling and French drains. The ballast, however, may be selected. A hard durable stone, crushed in angular fragments, in size from one inch to three inches, screened free from all dust and dirt, is the ballast that will least affect the mechanical life of the tie.

CHAIRMAN STERLING: This is a very important subject, and the Association is certainly fortunate in having it presented in such an able way. There will be a few moments available for the discussion of this paper, and in view of the short time at our disposal I will ask you to make your remarks apply directly to the paper and condense them as much as possible.

MR. WM. A. FISHER: Mr. Chairman, I should like to ask if, in the opinion of the author of the paper, the tie plates, even where fine gritty ballast occurs, do not practically do away with that grinding action? It would seem that the tie plate being almost an integral part of the tie the wear would come between the rail and the top of the tie plate and that this bad feature of that particular class of ballast would not apply under those circumstances.

MR. EARL STIMSON: That point is mentioned in the paper. There are some forms of tie plates that can be considered part of the tie. A flange bottom tie plate of proper design will cut into the tie and firmly engage the fibers of the wood, so as to hold securely to the tie. Flat bottom tie plates that are held to the tie by lag screws, independent of the rail spikes, become essentially a part of the tie. With these two forms of plates very little effect of the abrasive action of the grit under the tie plate is felt.

CHAIRMAN STERLING: Is there any further discussion?

MR. J. H. WATERMAN: I was asked to discuss this paper. I want to ask a couple of questions. I would like to know if Mr. Stimson has an opinion on cinder ballast and what effect it has on the tie, and has he had any experience with sand for ballast?

MR. EARL STIMSON: I have had experience with both cinder and sand ballast and will state that they have very little effect on the mechanical life of the tie if the ballast is kept well away from the bottom of the rail and the top of the tie.

MR. J. H. WATERMAN: My observation has been that on the mechanical life you are right, but sand takes hold of the tie and destroys it, causes it to decay more rapidly than any other ballast, and cinder next. That has been my observation.

CHAIRMAN STERLING: I wonder if Mr. Finley of the North Western could not give us a word on this question?

MR. W. H. FINLEY: All I can say is that the point brought out by Mr. Stimson is, I think, quite correct. I still think, however, with the sand ballast you would have that grinding action between the rail and the tie. I think it would be physically impossible to keep the sand well enough away from the tie to prevent an accumulation between the bottom of the rail and the top of the tie. I am inclined to agree with the last speaker that sand is probably one of the worst ballasts for the destruction of the tie.

CHAIRMAN STERLING: Is there anyone else present who was definitely assigned to discuss this paper? If not, are there any further remarks? There being none, we will consider this subject closed and proceed with the paper on "Additional Facts on Treated Ties," which Mr. Waterman is going to summarize for us.

MR. J. H. WATERMAN. Mr. President and gentlemen, I objected to preparing this paper, but your persevering Committee on Program insisted that I should. I did not like to present the paper and I will tell you why. If you give facts and they do not just fit the fellow, that is, they hurt him, why then you are up against it.

ADDITIONAL FACTS ON TREATED TIES.

By J. H. Waterman.

Last year I prepared a paper subject, "Some Facts Which I Have Gathered from Observation and Inspection of Experimental Ties."

You will note this is entitled "Additional Facts on Treated Ties."

Six months of the past year, all the time that I could spare from my office, I have spent in investigating treated ties and I have gathered some facts which to me are remarkable, and I expect to give these facts to the Association as I saw them and I will let you draw your own conclusions.

In my paper a year ago I emphasized the results which had been obtained from ties treated with Zinc Chloride because I gathered more facts about ties treated with Zinc Chloride than ties treated with other processes. Some of you gentlemen felt that I leaned toward Zinc treatment entirely which is not a fact and in this paper you will get more facts about ties treated with Zinc Chloride than ties treated with other processes because more facts are available.

As you all know there are several methods of treating ties,

Full Cell Creosote.
Empty Cell Creosote.
Zinc Chloride (Burnettizing Process).
Emulsion, Creosote and Zinc.

Ties Treated by Full Cell Creosote Process.

It is unnecessary for me to make any comments on ties treated with Creosote, full cell process. Every one knows and no one questions the facts that ties or timber so treated, receive the best treatment which is known today, and if the ties can be protected from mechanical wear, they will last twenty-five or more years.

In inspecting ties treated by this process in experimental tracks on the Burlington Railroad, I found some interesting facts. We placed in these tracks a number of cottonwood ties treated by this process, and they, although a softwood, are giving us most excellent service, and they are in as good condition as any other ties treated by this process in our experimental tracks and we have a large number of different kinds of woods so treated.

Another thing I noted that a tie treated by the Full Cell Creosote Process did not rail cut as badly as ties treated with Zinc Chloride. I account for that from the fact that the creosote is drawn to the surface more or less from the rays of the sun and in a measure lubricates the wood under the rail. I want you to note this for I will later make the same point on ties treated with Zinc and Creosote.

Ties Treated With Empty Cell Creosote.

I know very little about the Empty Cell Process. I wish we could get some facts as to the results obtained from the Empty Cell Process, but I had no opportunity to gather any facts. I have seen a good many ties treated with the Empty Cell Process that in my judgment were not properly treated. I remember going with my friend Mr. E. A. Sterling to a plant where they were using this process in treating ties, and I will never forget what we saw. The ties looked as though they had been dipped, not treated. However, I saw this year on the Illinois Central Railroad pine ties treated with the Empty Cell Process that seemed to be treated thoroughly. I bored in a number of them and they showed evidence of proper treatment. I found on other roads—I will not mention them—ties that showed evidence of very poor treatment with this process.

Ties Treated With Zinc Chloride, (Burnettizing Process).

I traveled over a good many different Roads this year trying to get data on ties treated with Zinc Chloride as well as other processes. I was received by the departments in charge of the timber treating on the various roads most cordially, but I find that human nature is the same on other railroads as it is on the Burlington Railroad, that if we have a good thing and tried it out, and have had most excellent results we like to stand on the house tops and spread it abroad throughout the land; but if we have tried out something and it has failed we are not so anxious to tell our friends and neighbors of our failures.

Our good friend, the President, Mr. George E. Rex, detailed a man to go with me over part of the Santa Fe Line and in Western Kansas they have most excellent results from ties treated with Zinc Chloride (Burnettizing Process.) They have ties laid in experimental sections which were laid in 1904 and 1905. Practically all of the ties in these sections treated with Zinc Chloride gave them nine years life before they began to remove them.

Between mile posts 182 and 183 on the section near Newton, Kansas, ties were laid out of face in 1904. We counted 823 ties had been removed in 1914 and prior to that date. Estimating 3,200 ties to the mile you will see that 25 per cent. had been removed, and 75 per cent. was still in track. There is no question, but what ties treated

with Zinc Chloride will give eleven to twelve years average life in that district.

On the Illinois Central Railroad I found that ties treated with Zinc Chloride in 1904 were giving much better service than ties treated later in 1907. There may be many reasons for this, but I am not prepared to give them.

I went over several other railroads, but did not get any data more valuable than we have on the Burlington Railroad. In a measure I must repeat some of the things I said last year about ties on the Burlington, and here I will insert in this paper a copy of our annual report on two experimental tracks on the Burlington Railroad. I am inserting these reports as they are in our files because they give you all the data and all the information which I have up-to-date in connection with these two experimental test tracks, and it is not a dream but they are facts. They are reliable because you will note I have responsible witnesses.

Wyoming District.

Report of Experimental Ties—Alliance Division.

LOCATION—Near Mystic, S. D., East end of Bridge 73, and laid a little over thirty rail lengths.
KIND OF BALLAST—Limestone and Black Hills dirt.
TIE PLATED OR NOT—Full tie plated.
WEIGHT OF RAIL—75 lbs.
RAIL CHANGED—Outside rail of curves changed in 1909.
WEIGHT OF RAIL ORIGINALLY IN TRACK—75 lbs. laid when ties were laid.
WEIGHT OF RAIL NOW IN TRACK—75 lbs.
DATE CHANGED—Fall of 1909.
BLUE PRINT REFERENCE—No blue prints.
KIND OF TIMBER—Red oak.
WHERE TREATED—Edgemont, S. D.
WHEN TREATED—1900.
HOW TREATED—Burnettizing Process (Zinc Chloride).
WHEN LAID IN TRACK—October 1, 1900.
NUMBER ORIGINALLY PLACED IN TRACK—550.
NUMBER STILL IN TRACK—479.
WHEN LAST INSPECTED—October 7, 1914. By W. M. Weidenhamer, Supt., C. C. Holtort, Asst. Supt., J. T. Gilmore, R. M.; G. F. Hamilton, Engr., C. F. Ford, Engr., Rock Island, John Lind, Sec. Foreman and J. H. Waterman.
REMARKS—This lot of experimental ties was placed in track in 1900.
Note they are red oak ties. They were treated at Edgemont, S. D.
We have no definite information, but the probability is that they were treated with one-third pound of Zinc Chloride per cubic foot. They were treated with Zinc Chloride (Burnettizing Process.) They were laid in the Black Hills on a 3 per cent. grade and a 12 degree curve. 100 per cent. of them gave us twelve years life.
In 1912 3 were taken out for the Laboratory.
In 1913 18 were taken out account decay.
In 1914 50 were taken out account decay.

Total 71 taken out to date or a little less than 13 per cent.
87 per cent. we know will give us fifteen years life.
There is every reason to believe that 50 per cent. of the ties that were placed in track will give us eighteen to twenty years life.
The ballast under these ties is limestone and Black Hills dirt, excepting four or five rail lengths which is cinders. We noted in our annual inspection 1914 that most of the fifty ties which were taken out, came out of the track where the cinders were used, which would indicate that cinder ballast is very hard on ties.

Wyoming District.

Report of Experimental Ties—Sterling Division.

LOCATION—Two miles of track between Sidney, Neb., and Peetz, Colo.
KIND OF BALLAST—Peetz gravel.
TIE PLATED OR NOT—Curves tie plated.
WEIGHT OF RAIL—75 lbs.
RAIL CHANGED—No.
WEIGHT OF RAIL ORIGINALLY IN TRACK—75 lbs.
WEIGHT OF RAIL NOW IN TRACK—75 lbs.
DATE CHANGED—
BLUE PRINT REFERENCE—No blue print.
KIND OF TIMBER—Black Hills Pine.
WHERE TREATED—Edgemont, S. D.
WHEN TREATED—In 1900.
HOW TREATED—Zinc Chloride.
WHEN LAID IN TRACK—Fall of 1900 and winter of 1901.
NUMBER ORIGINALLY PLACED IN TRACK—2 miles of track (6354).
NUMBER STILL IN TRACK—5,966.
WHEN LAST INSPECTED—October 6, 1914. By G. L. Griggs, Supt., J. Toohey, R. M., C. F. Ford, Engr. Rock Island, G. F. Hamilton, Engr., and J. H. Waterman.
REMARKS—Between Sidney and Peetz in the fall of 1900 and winter of 1901 there were originally laid fourteen miles of zinc treated ties out of face. This was during the construction of the line. In 1913 over 95 per cent. (estimated) of ties were still in track. We then decided to take two miles of tangent, stake it off and use it as an experimental track. The reason we took two miles is because it is much easier to take care of two miles than fourteen miles, and get definite results.

There were originally laid in this track 6,354 ties.

Up to and including 1913, in the two miles of track were taken out account decay	285
In 1914 we took out account decay	103
Total ties taken out to date	388

Total percentage a little over 6 per cent. taken out.

These ties were treated with a little over one-third pound of Zinc Chloride—to be exact between .33 per cent. and .40 per cent. Zinc Chloride per cubic foot.

Note 94 per cent. of these ties have already given us fourteen years service which indicates that in the dry climate of the West, ties properly treated with Zinc Chloride will give good service.

These ties are not tie plated.

Aside from the experimental tracks referred to above we have on the Sheridan Division, in Wyoming and South Dakota, thousands and thousands of fir ties treated with zinc which were placed in track in 1901, 1902 and 1903.

We also have thousands of red oak ties treated with zinc placed in track in the Illinois District in 1902 and 1903.

Ties Treated by the Wellhouse Process.

The C. & E. I. Railroad have some very valuable information on ties treated with an emulsion.

On June 24, 1914, with an engineer from the C. & E. I. Railroad, I went over their line from Cypress to Joppa.

In that line they placed in track in 1900, 24,271 red oak ties.*

By actual count in June, 1914, there were still remaining in track 18,045 red oak ties, or practically 75 per cent. of the ties originally

*Treated with the Wellhouse Process, which means zinc, glue and tannin. The glue and tannin are a plug to keep in the zinc. These ties were not treated with Straight Zinc as has been presumed.

placed in track. When these ties were placed in track there was a dating nail put in them, and when they say "by actual count" they had a man from the Engineering Department count every tie still remaining in track that had a dating nail in it. In other words 75 per cent. of those red oak ties gave them fourteen years life.

On June 26 near Mt. Vernon I saw a number of red oak ties in track treated with the Wellhouse Process bearing dating nails 1899, which had given them fifteen years service.

The C. & E. I. have a fine record of the ties placed in track between Cypress and Joppa.

The red oak ties on the C. & E. I. line treated with the Wellhouse Process in 1900, 1901, 1902, 1903 and 1904 are in a very good state of preservation. In other words, they will get most excellent results.

Please bear in mind that these ties were treated with zinc, glue and tannin, Wellhouse Process and not Straight Zinc.

How do I know?

Because we went to Mt. Vernon and went through the records, and found that the ties were treated with what is known as the Wellhouse Process, zinc glue and tannin.

There is not a man in this audience who is familiar with the name of Octave Chanute, but knows that he was a man of very high ideals and nothing would tempt him to vary from his best judgment, and he believed that ties treated with the Wellhouse Process, zinc, glue and tannin would give better results than Straight Zinc, and he said during his later years that railroads had drifted from that treatment, but there was a time coming when they would go back to it.

The facts given above on ties so treated on the C. & E. I. Railroad bear out Mr. Chanute's judgment.

Ties Treated with an Emulsion. (Card Process).

The Burlington Railroad, until the price of creosote was advanced, treated their ties with the process known as the Card Process, which is an emulsion of Creosote and Zinc. We have in our experimental tracks thousands of ties so treated. It is too early to draw positive conclusions from the experimental tracks on the Burlington Railroad on this treatment. However, I am here to say to you gentlemen that ties treated with Creosote and Zinc show less mechanical wear under the rail than ties treated with Straight Zinc, and I give the same reason for this result that I gave under the heading, "Ties Treated by the Full Cell Creosote Process." The oil in the ties treated with Creosote and Zinc, is drawn to the surface, and it lubricates the tie and the rail and causes less rail cut and surface wear. It also prevents the ties from checking. From close observation in our experimental tracks I find that ties treated with Straight Zinc check more

with the heat of the sun's rays than ties treated by the Full Cell Creosote Process or ties treated with Creosote and Zinc. The oil in the ties moistens the surface of the tie and so prevents the wood from checking.

The Full Cell Creosote treatment of ties is out of the question. The cost makes it prohibitory so we are left to choose between a light treatment of oil, Straight Zinc or an emulsion, Creosote-Zinc treatment.

One of our most able treating engineers in this country who has gone up and down through this land in season and out of season preaching and teaching users of materials and especially the railroad managers that they should use treated ties, a man whom, where he has gone, you can trace for he has educated many men that know little of treatment, what they must expect if they fail to treat their ties. This man, Dr. Herman von Schrenk, in a paper prepared for the American Forestry Congress, 1905, presented the following table:

Table Showing Annual Charges.

Timber and Treatment	Length of Service	Original Cost	Cost of Treatment	Annual Charge
White Oak, *Untreated*	10 years	$0.85	.....	$0.121
Red Oak or Loblolly Pine, *Untreated*	5 years	.40	.....	.124
Red Oak or Loblolly Pine with Zinc Chloride Treatment	10 years	.40	$0.16	.085
Red Oak or Loblolly Pine with Zinc Creosote Treatment	16 years	.40	.25	.065
Red Oak or Loblolly pine with Creosote Treatment	20 years	.40	.45	.069

In conclusion he said in part:

"No treatment can be seriously considered which costs more than 25 to 30 cents. Wood is still cheap, and until the original cost of a tie goes to $1 or thereabouts cheaper treatment must prevail. Of those advocated I would advise using the best; in other words, considering the investment from the first standpoint, that of annual charges. This would mean either a cheap creosote treatment, one using small amounts of oil with as good penetration as can be obtained) or a zinc-creosote combination, both of which would cost 20 cents or thereabouts."

I would be glad to quote more from the paper because it is very valuable, but you will note that then Dr. von Schrenk appreciated the value of a creosote and zinc combination and I believe he does today.

Gentlemen, I have tried to confine myself to facts as I saw them. The railroads of this country use most of the material which is treated. We owe it to the management of the railroads to give them facts, not theories, and I shall be glad to see the day in this Associa-

tion when there is a Committee appointed on facts about treated material, and I believe that this Committee should report annually to the Association facts as they gather them and facts need no apology. They may or they may not be in the interests of what we term the best practices today, but this Association should be big enough and broad enough and aggressive enough to present facts regardless of how it may affect individual members of the Association and I believe, Mr. President, that this Association is big enough and will at our annual meetings gather all facts that are available on treated material, discuss them intelligently and present them to the management of the great railroads of this country who are most vitally interested.

Gentlemen, I thank you for your attention.

CHAIRMAN STERLING: Has anyone a remark or suggestion to offer on Mr. Waterman's paper? If there is no discussion we will proceed with the program, next having the privilege and pleasure of listening to an illustrated talk by Mr. F. J. Hoxie, Engineer and Special Inspector of Treated Timber for the Associated Factory Mutual Insurance Companies. Mr. Hoxie is known to most of you probably through his reports and investigations on various phases of the use of timber in mill construction.

MR. F. J. HOXIE: I am in the employ of a group of fire insurance companies, and we are interested just now in the life insurance of timber. I do not propose to tell you, gentlemen, how to treat timber, for I do not know how, but I want to place before you the problem of rot-proofed timber for factory construction, and, in order to give you in the quickest possible way a silhouette of the causes and the extent of destruction of structural timber, I will show you some pictures of the rotted wood and the fungi that have destroyed it.

The Associated Factory Mutual Fire Insurance Companies of New England have been insuring factories of heavy timber construction for something like 75 years, and during that entire time and at the present time strongly recommend to their members this so-called slow-burning construction in preference to steel, which would seem at first sight to be more fire resistant. We are just now paying about $26,000 for a building supported on steel girders. This steel was softened and caused to fail by a comparatively small fire in which heavy timbers would undoubtedly have held their load much longer.

The increasing prevalence of rot within the last few years in varieties of timber which are now commercially available for mill con-

struction has, therefore, been regarded by our Companies as worthy of the most careful study.

I suppose you are familiar with the so-called mill construction. It consists of 3 or 4-inch planks supported on heavy beams spaced 8 or 10 feet apart. Sometimes the floors are made 5 to 8 inches thick by placing the planks on edge. This so-called laminated floor is frequently found in storehouses designed for heavy loads. Such floors are giving a great deal of trouble from rotting, which is brought about by two causes. First, timber which is wet when put in place dries slowly, owing to the great thickness; second, the storehouses are rarely heated and, therefore, drying is slow at best.

We are not wedded to any particular form of timber treatment. That which will produce the best results for its cost under the conditions which prevail in the various manufacturing processes will find greatest favor with us. Corrosive sublimate looks most promising of anything thus far.

Fire insurance people are interested in timber treatment, because rotted timber ignites at a lower temperature, burns more persistently and fails to support its load earlier in the progress of a fire. Rotted fire doors, which are found with increasing frequency, are deficient in the high power of resistance to heat which has been found in doors made of sound material. Rotted roof planks cannot support the sprinkler pipes in a fire as long as sound planks.

Much of the timber being sold at the present time contains living fungus and when put into a structure with suitable conditions of moisture it starts at once into active growth and not only destroys the sticks in which it was originally but spreads to other nearby susceptible material, causing general destruction.

It is difficult, or impossible, to obtain large quantities of timber treated as required for use in factory construction in the short time which is frequently available. This has resulted in treating timber in a few cases in factory yards with home-made tanks. The cost has proved satisfactory, averaging about $3 per 1,000. One of these tanks is of concrete, built on the ground, and about 2 feet deep. The roof plank treated was placed in the tank and weighted down to prevent floating. A sufficient amount of 1 per cent. solution of corrosive sublimate, dissolved in water, was then added to submerge all of the planks, and they were allowed to soak for a week.

The absorption varies from 3 or 4 per cent. to 40 per cent., depending upon the percentage of sapwood, latent fungus, etc. The penetration is small, generally not over 1/8 inch in sound heartwood. The sapwood is generally penetrated throughout. The tank used has a capacity of 100,000 feet, board measure, of 2-inch plank.

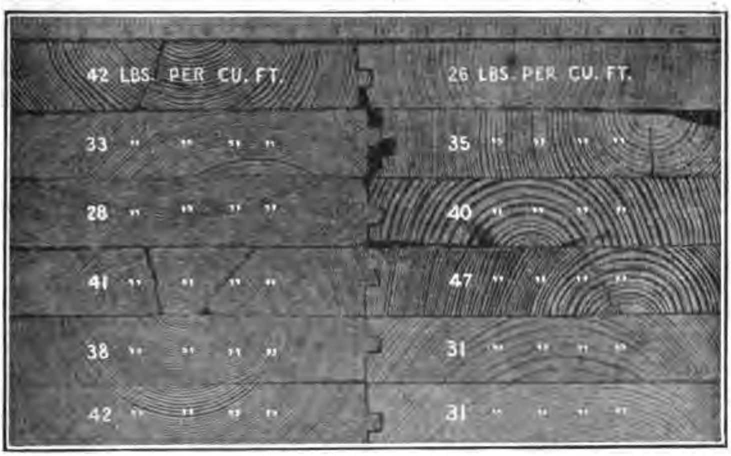
Gentlemen, I thank you for your kind attention.

TREATED TIMBER FOR FACTORY CONSTRUCTION.

By F. J. Hoxie,

Engineer and Special Inspector, Associated Factory Mutual Fire Insurance Companies.

It is becoming difficult to get timber for mill construction of uniform good quality with sufficient natural resistance to withstand fungus unaided in the moist atmosphere of textile and paper mills. Longleaf pine of high natural resistance is to be had, but by present selling and grading methods there is frequently mixed with it enough light porous material to destroy the reliability of the lot for important uses. The following photograph is an example of the wide range of densities now being sold as good longleaf pine. As a result of the poor quality



of timber practically obtainable and the higher factory humidities in common use antiseptic treatment of mill timber and planking is becoming a necessity.

Little experience is available to guide the pioneer in the preservation of mill timber. That which has been treated in the past has been used for basement floors, bridges, and other construction near or in contact with the earth, where the conditions are somewhat similar to those which you have successfully met in treating railroad ties. The problem of mill frames and floors is different in several respects. Leaching is of little importance. Fire hazard with enclosed rooms containing large values demands the most careful consideration. The strength of the frame supporting a high building filled with processes involving wide variations in temperature and dryness, and subject to

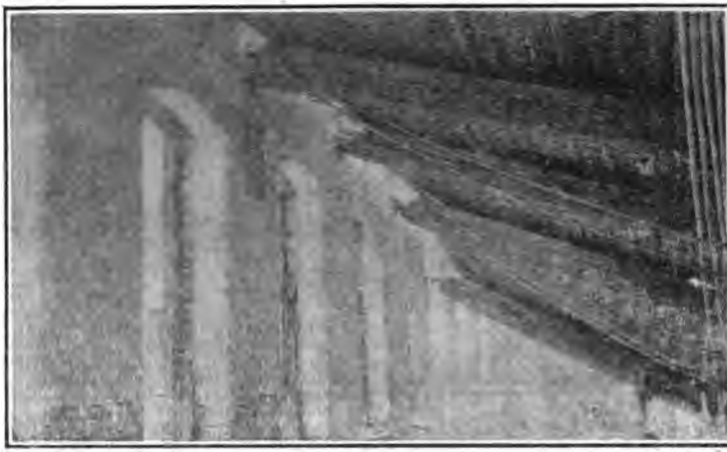
Beams in a cotton-weaving mill basement completely rotted across from the increased relative humidity caused locally by a cold-water pipe passing under the beam. It will be noted that the rot is confined to a space about 2½ ft. distant from the water pipe, the remainder of the beam being perfectly sound, showing that a slight change in the relative humidity is sufficient to cause serious rotting, other conditions remaining the same.

the constant shock and vibration of moving machinery must be safeguarded against deterioration over long periods of time.

Fewer botanical varieties of timber are practically available for mill construction than for railroad ties. This simplifies the problem as each variety of tree has its own fungus destroyers. Moreover the varieties of fungi which attack a given variety of wood are further limited by moisture and temperature requirements, in which most of them are very exacting. It is, therefore, to be expected that only a few varieties of fungi will be found in mill buildings.

The railroad tie in contact with the earth is subject to continuous attack by mycelium as well as spores from fungi flourishing on nearby decaying vegetation. Such sources of infection exist to a much less degree in a building with smoothly painted ceilings and clean floors. As a result, timbers of moderate natural resistance, such as good quality longleaf pine, heart wood without antiseptic treatment have proved entirely satisfactory for mill construction in the past. It is, therefore, to be expected that much less elaborate preservative treatments than those in use for railroad ties will satisfy the requirements of mill timber.

Members of the polyporous family cause much damage to mill roofs and basement floors where excessive moisture is prevalent. A reduction of the moisture will generally arrest them, but this is not



A factory of slow-burning construction with the bearing ends of the beams burned entirely away, although the main body of the beams is not deeply charred. This is probably the result of fungus in the wall bearings.

Part of the white pine beams and oak columns taken from a cotton factory in Central Canada, where the frame of an entire floor was destroyed in a few years by dry rot, apparently brought in in material used for a temporary floor in the basement.

Merulius lachrymans, or dry rot plant, growing on a lobolly pine beam taken from a Canadian cotton factory.

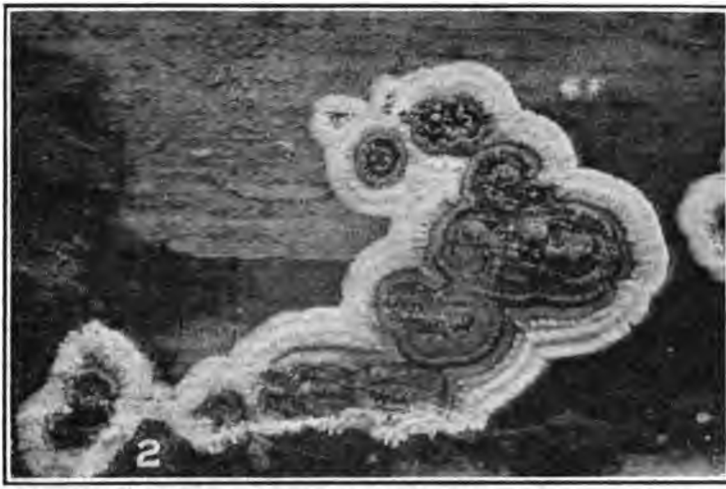
often possible, owing to necessities of manufacturing processes.

Dry rot fungi are able to carry on their work of destruction with a much smaller water supply. They have a treacherous resting state and are frequently brought into a building with the lumber. Their rapid growth and destruction of new buildings as well as old, makes them particularly dangerous.

Merulius lachrymans has not been considered common in this country, but from the many widely separated places in which it has been found it is by no means absent and not to be disregarded as a destroyer of structural timber. It is probable that the chief reason that it has been mentioned so infrequently in the past is that timber in common use has had a high natural resistance to it. Fruiting plants of the merulius lachrymans and coniophora cerebella have been found associated with some of the most serious cases of rot investigated.

Merulius lachrymans must have the wood prepared for it by coniophora cerebella or some other acid producing fungus, is the conclusion of Dr. Falck. A regular sequence of fungi on a rotting stump is frequently observed. The study of wood treating processes should be further simplified by this peculiarity as it may be necessary to stop only the primary invaders to arrest their followers.

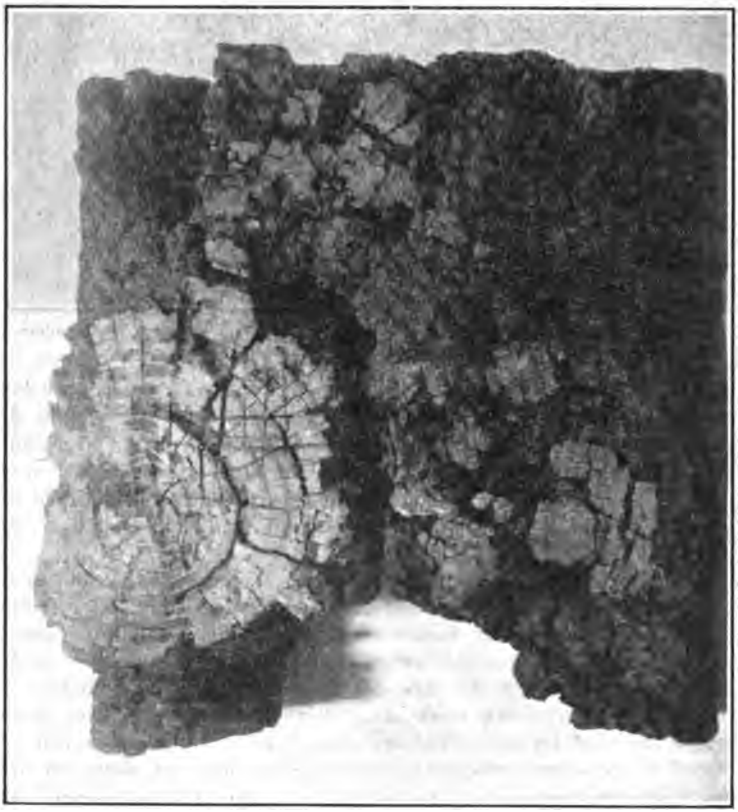
The present methods of handling loblolly and shortleaf pine timber are disastrous not only to the purchasers, but to the lumber industry. The timber is generally of reasonable strength and would make excellent material for many purposes if kept sound, but the high susceptibility of its broad sap wood to fungus attack makes it an ideal cultivating ground of destructive fungi with the result that it is not



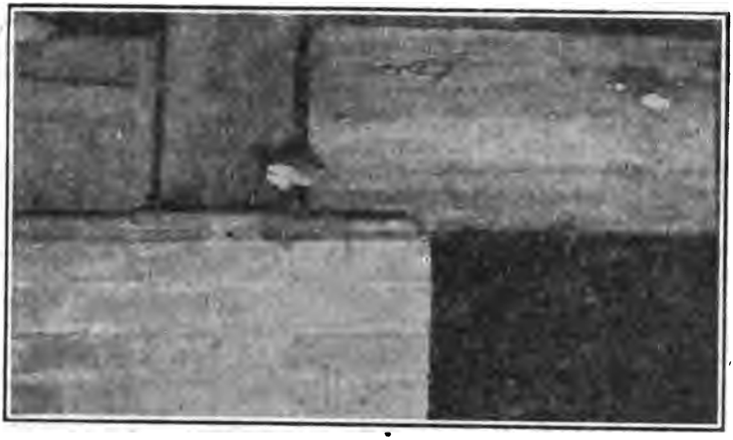
Coniophora cerebella growing on a loblolly pine beam taken from a Canadian cotton factory.

only rapidly destroyed itself, but frequently carries dangerous wood destroyers into buildings previously sound. In one case a mill 25 years old, with oak posts and white pine beams was found in a dangerous condition from dry rot, brought in apparently in boards used for making a temporary floor in the basement. Such timber should be given a suitable antiseptic treatment as soon as possible after it leaves the saw.

The facility with which new lumber can pick up infection, even when handled with unusual care, is almost incredible. I recently received from a Southern lumber manufacturer four samples of short-leaf and loblolly pine which were sawed from the logs in the woods and placed directly on the cars, not associated with other lumber. I received them within a week after they were shipped. They were bright and with no signs whatever of any form of fungus growth. I placed them in my cellar at an average humidity of about 90 per cent. In the course of a few weeks a fungus growth appeared on the sapwood. This continued to increase during the summer months, the samples having been received in the late spring. In the early autumn fruiting plants appeared. The increasing dryness of the atmosphere arrested them, so that it was not possible to determine the variety with certainty. If logs can be infected under such conditions, there is little hope for sapwood which after being sawed fresh from the forest is closely piled on cars or in the holds of vessels for a voyage of several weeks, later being placed in lumber yards where destructive fungi is almost always present, merulius lachrymans not



The bottom of a 16 x 16 in. column of loblolly pine recently taken from an Ohio paper mill. The wood had completely rotted and the column settled under its load. The disease was undoubtedly started by the mill being partly submerged in the recent flood.



Fomes roseus growing on a hemlock beam in a moist cotton factory basement. This fungus has only been found in conditions where the atmospheric humidity was nearly or quite 100 per cent. most of the time. Under such conditions it has been found very abundant and very defective to spruce and hemlock timber.

Rotted floor and beams under a New England woolen mill, showing the floor entirely destroyed and being replaced with concrete. The moisture in this basement was most of the time nearly 100 per cent. The cause of the destruction was undoubtedly fomes roseus and trametes serialis. Two or three other varieties of fungus were found growing here, but fruiting plants of the above-named varieties were most numerous and undoubtedly chiefly responsible for the destruction.

being uncommon. In one very serious case investigated, there is little doubt but that the disease spread from timber to timber while piled in the mill yard awaiting erection. This would undoubtedly have been prevented by a suitable superficial antiseptic treatment of this material at the saw mill.

The combustibility of heavy timber construction with automatic sprinkler protection has not been found to be a serious objection in buildings in which this form of construction has advantages from cheapness, convenience in hanging shafting or comfort of employees. A useful property of importance in paper mills and weaving mills with high atmospheric humidity is the heat insulating power of heavy plank roofs. It would undoubtedly be advisable in many cases to make the roof an inch or two thicker than strength alone requires, with this object in view, as sweating roofs damage goods and are otherwise troublesome. With thick roofs it is absolutely necessary to have lumber which is immune to fungus under the conditions which prevail. If material of sufficient natural resistance cannot be obtained at a reasonable price, antiseptic treatment is imperative.

Coal tar compounds which you are extensively and successfully using for railroad ties and other timber in exposed situations, are not generally adapted to factory construction, owing to the black, greasy surface which they leave, their somewhat disagreeable smell and chiefly the increased fire hazard. In a recent fire the Factory Mutual Fire Insurance Companies paid a loss of about $60,000.00 on a paper mill where a coal tar compound had been used on the roof planks. Those who were present at the fire stated that this compound undoubtedly contributed much to the loss in rapidly spreading the fire over the entire roof.

A paper by Mr. H. M. Rollins entitled "Inflammability of Treated Timber" together with the discussion in the proceedings of this Association for 1910 indicates that railroad ties and telegraph poles that have been creosoted are rather less combustible than those which have not. A part at least of this apparent fire resistance can be accounted for by the fact that the sound wood of the preserved material is considerably less combustible than the punky wood of that which has been attacked by fungus. The rapid escape of the heated gases from the immediate neighborhood of the burning material is also a factor with fires in the open air. Conditions in mill buildings are quite different. The closed rooms can retain the heat generated by the burning oil, rapidly raising the temperature to the ignition point of the wood, extending the fire and increasing the water and smoke damage to the contents.

Chloride of zinc which is extensively used on railroad ties has, so far as I am aware, been used in mills to only a very limited extent

Fifteen sections of 8 x 18 in. beams from the frame of a Canadian factory, which rotted so badly within about three years after it was completed that it was found necessary to remove the entire frame, consisting of 1,000 beams and columns.

Lenzites sepiaria growing on a roof plank which had been removed from a New England cotton mill. Plank roofs of cotton mills and paper mills, where high atmospheric humidities are common, rot very rapidly. It has not been possible to determine with certainty the fungus plant which is responsible for this destruction, as it is rarely, if ever, that fruiting plants can be found on the roof before it is removed from the mill.

Tin-clad fire-door of white pine completely destroyed by rot within three years after it was installed in a new Massachusetts cotton factory.

Magnified 75° Diameters.
A photomicrograph showing one of the polyporus fungi passing through the cells of Douglas fir.

and practically no data are available as to its value. The suspicion that it may gradually decrease the strength of the timber over long periods of service or when subjected to elevated temperatures would cause it to be regarded with disfavor until further proof of its harmlessness is forthcoming.

Corrosive sublimate has been used somewhat in the past with good results. Little experience is available as to its serviceableness when applied to mill timbers, although basement floor planks, fence posts, parts of bridges, etc., are in use about the Lowell mills which have been treated with it at various times within the past sixty years and which are reported to have given satisfactory service. A paper presented at the last annual meeting of this Association by Dr. Frederick Moll states that wood treated with corrosive sublimate is in extensive and successful use in Germany and Austria. Malonkovic regards corrosive sublimate as an effective wood preservative when applied in an open tank with comparatively little penetration, owing to its high toxic power and to the fact that it forms an insoluble compound in the wood cells which make it permanent.

For treatment of mill timber an inexpensive process which can be applied on the job after the timber is cut to final shape has many advantages. In several cases where timber has recently been so treated with corrosive sublimate the cost and convenience have been very satisfactory.

From the limited information thus far available the corrosive sublimate process appears to be best adapted to the general requirements of mill timber. Fluorine compounds have shown good results in laboratory experiments but no practical experience with them is available. The cheapness of chloride of zinc or sodium fluoride would not give them a great advantage over corrosive sublimate, as the cost of the chemicals is a comparatively small item in either case, when

Part of nineteen 12 x 16 in. beams removed from a Connecticut cotton factory after two years' service. One of them broke under a light load. It is evident that the disease was brought in in the timber from the South, and continued to progress after being put in place in the mill.

Magnification 75° Diameters.

Photomicrograph showing coniophora cerebella in the cells of loblolly pine. This fungus goes into a dangerous resting state, in which it apparently retains its vitality for some years.

A hemlock beam crushed under a light load in the moist basement of a New England cotton factory after about two years' service.

used in open tanks and would be easily compensated for by the greater toxic power of the mercury salt.

In conclusion, there is no doubt but the value of the mill timbers which rot each year is a sufficiently large sum to make preservative treatments well worth while. When the problem is narrowed down to the conditions of moderate exposure in the mills the few woods available for mill construction and the few fungi that commonly destroy them, it is probable that a reasonable cheap and convenient process such as corrosive sublimate in an open tank will satisfy all requirements if applied soon enough. Probably a light treatment at the saw mill and another after being cut to final shape and ready to be put in place in the mill frame will be found most serviceable.

MR. C. M. TAYLOR: While we are waiting for the lights to be turned out I wish to make a motion. In view of the discussion this morning, I would like to move that the paper by Dr. von Schrenk and that by Mr. Reilly be submitted to the Committee on Preservatives.

MR. F. D. MATTOS: I second the motion.

CHAIRMAN STERLING: Gentlemen, you have heard the motion, which is to the effect that the paper by Dr. von Schrenk and the one by Mr. Reilly be submitted to the Committee on Preservatives. Are you ready for the question? All in favor of the motion will signify it by saying Aye; opposed, No. The motion is carried.

(President Rex then took the chair.)

MR. WM. J. TOWNSLEY: Mr. President, would it be a feasible thing to have at least a selection of these slides reproduced in the Annual Proceedings?

THE PRESIDENT: We certainly will, Mr. Townsley. We expect to have them printed, the more important ones at least, if Mr. Hoxie can give them to us for our publication.

MR. F. J. HOXIE: You are entirely welcome to use any of them in any way you see fit.

THE PRESIDENT: This is a very important matter and touches practically a new side of our industry—the preservation of timber for building purposes. I think if we could have the time to thoroughly discuss this paper and bring out the points connected therewith that we would succeed in inducing the building public to treat a large part of the timber and do away with this trouble that Mr. Hoxie is finding. There is one point in regard to Mr. Hoxie's paper that I am going to ask discussion on, and only one, and that is in regard to the preservative. I would like to call upon Mr. G. B. Shipley to lead this discussion.

MR. GRANT B. SHIPLEY: I do not believe I have anything to say, Mr. President, just now.

MR. EDW. F. PADDOCK: Mr. Hoxie in his paper has omitted to mention one point in regard to the fire resistance of timbers treated with zinc chloride. About a year ago I was in charge of some tests on longleaf pine timbers treated with various preservatives, among them zinc chloride, to determine the ignition point and combustion loss of these timbers. Mr. Hoxie was present at the time and witnessed some of these tests. The interesting thing in connection with the zinc chloride treated timber for factory purposes was this, that while zinc chloride treated yellow pine had a much higher ignition point than any of the oil treatments that were used, its combustion loss was considerably greater. After the blocks were ignited they were allowed to burn until the flame went out and were then laid aside. About 2 or 3 hours after the flame went out I took them outside and photographed them, and in carrying them out they began to smoke. In other words, the fire, while it had apparently died out, was glowing inside and gradually eating into the timber. We found in some cases this had gone on to a depth of perhaps 2 inches into the timber, and when they were exposed it began to glow and gave off sparks. This is an interesting fact in regard to the salvage which occurs after a fire, for even after the fire is apparently extinguished the timber may continue to glow and requires only a slight draught to fan it into flame. We found the loss in weight by combustion and the reduction in cross-section, due to ignition, was greater in the zinc chloride treatment than it was in

either creosote, water-gas-tar, Avenarius Carbolineum or untreated wood.

MR. WM. J. TOWNSLEY: Would it be possible to know what quantity of zinc chloride was injected?

MR. EDW. F. PADDOCK: Very close to ¼ pound of dry zinc chloride per cubic foot was absorbed by the blocks, which were 6-inch sections cut from 6"x8" longleaf yellow pine switch ties.

MR. WM. J. TOWNSLEY: May I ask if at the same time you had the opportunity to test untreated wood under similar conditions?

MR. EDW. F. PADDOCK: Yes.

MR. WM. J. TOWNSLEY: You found a difference in their rate of combustion after the fire was apparently out?

MR. EDW. F. PADDOCK: Yes, the zinc chloride planks after they were removed from the treating device were brought in contact with the flame, and as soon as the block ignited it was removed to a table and protected by a wind shield. The time was taken for the length of the burning up to the time the flames were extinguished naturally, and we found that this amounted to something like an average of about 2 minutes for the zinc chloride blocks and for the oil treatments from 5 to 10 minutes.

MR. WM. J. TOWNSLEY: And for the untreated blocks?

MR. EDW. F. PADDOCK: For the untreated blocks about the same, 5 to 7 minutes. The loss in weight by combustion on the blocks treated with oils was remarkably small, less even than in the untreated blocks, and on cutting the blocks open we found the treated blocks were charged with very much slighter effect than even untreated blocks, but the greater destruction of the timber occurred in the zinc chloride treatment.

MR. S. R. CHURCH: Mr. President, Mr. Hoxie says that "coal-tar compounds, which you are extensively and successfully using for railroad ties and other timber in exposed situations, are not generally adapted to factory construction, owing to the black, greasy surface which they leave, their somewhat disagreeable smell and chiefly the increased fire hazard." With regard to his first objection, I think he has overlooked the fact that this is largely a matter of proper treatment. The commercial treating companies can solve Mr. Hoxie's problem to that extent. Properly treated timbers do not have a black, greasy surface. They may have a disagreeable smell, which renders creosoted timber unsuited for some interior uses, but this applies only to a comparatively small proportion of factory buildings. As to the increased fire hazard, I disagree with Mr. Hoxie in his differentiation between what happens when treated materials are subjected to contact with flame in the open air or in the interior of a building. I consider

that the former is a more favorable condition for combustion than the latter.

When timber treated with hydrocarbon compounds, such as creosote oil, burns, it produces in burning a large quantity of unconsumed carbon. There is heavy smoke. Creosoted timber burns with more smoke, but with less flame, than untreated timber, and there is a deposit of soot on the surface of the timber which acts as a very effective insulator against the rapid progress of the fire to the interior of the timber. In an interior fire there is less tendency for this smoke to be rapidly carried off by air currents than in an open-air fire, hence the insulating value of the carbon produced by the burning oil is more effective in the case of interior fires.

MR. J. H. WATERMAN: Mr. President I would like to ask this question: How long after the blocks were treated, the creosote blocks, were they tested by fire?

MR. EDW. F. PADDOCK: The period of air-seasoning after treatment was approximately 2 months.

MR. J. H. WATERMAN: That is good. They will burn quicker right from the retort than they will after they have seasoned 2 or 3 months.

MR. EDW. F. PADDOCK: In reply to Mr. Church's remarks, my experiments have not gone that far. In regard to the carbon forming on the surface, this was borne out in my own experiments with the creosote and water-gas-tar treatments. In all the heavier treatments that was very true, but in the lighter treatments there was not this formation of carbon on the surface, and the combustion loss was less in the lighter treatments than in the heavier treatments. The conclusion that I arrived at was that the greater part of the combustion loss was due to the distillation of the oil before combustion took place which would naturally result in greater loss in the more heavily treated specimens.

MR. C. J. HUMPHREY: Mr. President, I have had some experience in looking into these questions which Mr. Hoxie has been demonstrating here by pictures, and while I do not wish to enter into a discussion of the pathological problem itself, I would like to present certain opinions that I have reached in regard to the application of preservatives. I personally do not think that creosote and zinc chloride alone are sufficient for use in buildings, and we will probably have to supplement these preservatives to a large degree with other substances. We are not ready to recommend any particular substance yet, but we are working on them. I think it is to the interest of the various wood preservers to look into this question also and attempt to get substitutes. I have a good many requests from various sources for recommendations for eliminating certain of these fungous troubles and about all we

have is to recommend our usual sanitary measures and with them we usually need to recommend a suitable preservative or else we have to recommend steel or concrete. Of course, we in the Forest Service naturally want to recommend wood. Now, when you do recommend these preservatives it is often very difficult to obtain them in the small quantities necessary for the small user. That has been one of the main difficulties in their use. If we could have these preservatives and also treated wood on the market in a form available in small quantities so that the consumer could get them conveniently it would be a big step in advance, and I think that this is well worth the consideration of the members of the American Wood Preservers' Association. I hope to see this practice come into use some day.

MR. E. A. STERLING: Mr. President, the impression that I gather from Mr. Hoxie's paper is that he is talking and thinking in different terms of wood-preservation than most of you here as members of this Association are thinking and using on the same subject. I mean that this Association, generally speaking, represents the pressure treatment of timber by different processes and various preservatives. It is also my impression that the architects and the engineers, the men who consider the use of timber for mill construction or similar structural purposes, are not thinking in those terms, for the very simple reason that the essential facts regarding the kind of treatment we are talking about have not been presented to them. In other words, their line of thought runs to open-tank treatment, brush treatment and the use of the dollar-a-gallon preservative, speaking figuratively. It seems to me that this paper, entirely aside from its excellent technical points, shows one of the greatest weaknesses of this Association at the present time. It also indicates an opportunity which to my mind should be taken advantage of immediately. To be specific and brief, I mean simply that every architect and every engineer receive frequently and in more or less valuable form literature on certain proprietary preservatives that may be good or bad—that is immaterial—but the conditions are such that the use of those preservatives is explained and urged by brush and open-tank treatment. Has not the time arrived when the facts as to the kind of treatment should go all the way down the line? Is it not time that all of those facts were presented to everybody interested, particularly your man who sits back and waits for things to be given to him? Is it not the function of this Association to get into this big educational game and put into the hands of construction engineers and architects specifications, information, facts and statistics of what preservative to use and how to use it under particular conditions, reconciling all of the recommendations to service requirements, so that it will be known definitely whether and why and how treated timber can be used in mill construction and similar

purposes? What is said here about coal-tar compounds to my mind does not indicate whether or not they are a failure, because, as I understand it, they were applied superficially. We know that timber can be creosoted and come out dry, with practically little smell, and I believe that under many conditions and with proper educational work by this Association, a whole lot could be done toward promoting the use of treated timbers for various structures and purposes.

MR. EDW. F. PADDOCK: Replying to Mr. Sterling's remarks, the company which I represent has been for a good many years making investigations of all kinds in regard to open-tank and brush treatments. and I am sure that Mr. Sterling can rely upon us to give any help that we are able. We are only too willing to give him this assistance.

As far as the tests that I have been making are concerned, I spoke of creosote and water-gas-tar tests. These were not open-tank treatments, but the blocks were treated in a commercial plant with yellow pine ties.

THE PRESIDENT: Mr. Hoxie's paper has presented this very important subject to us as wood-preservers for solution, as I take it. He has discovered in his work the very great loss of timber from decay and he is simply presenting these facts to us for us to solve, and it is up to this Association to work them out. We want to heartily thank Mr. Hoxie for calling our attention to these matters and I hope that our committee will send out an invitation to Mr. Hoxie and see that we work in harmony with him in the future.

As regards Mr. Sterling's remarks about the motion, the promotion of timber preservation is one of the points that we have never been able to take up previous to this time, for the reason that we were not large enough. We are growing so rapidly, and so many things have come up in the space of the last two years in the development of this treating business, that we have not had the time to do the things which Mr. Sterling suggests, and the growth that we have had within this year and are having shows that we are fast reaching the point where we can take up just the points that Mr. Sterling is suggesting in the promotion of preservation generally. I have to close this discussion.

MR. WM. J. TOWNSLEY: Mr. President, may I ask the name and business connection of the gentleman who just replied to Mr. Sterling?

MR. EDW. F. PADDOCK: Paddock, of the Carbolineum Wood Preserving Company.

THE PRESIDENT: I want to announce before we go to the next paper that at 4 o'clock we will have the report of Committee No. 2. We will now hear from our friend, Dr. L. F. Shackell, of St. Louis.

DR. L. F. SHACKELL: I have two or three specimens of untreated wood that have been attacked by the marine borer with which I

have been working. I have also in these glass tubes a specimen each of Teredo and Xylotrya. I shall leave all here on the table for inspection.

I desire to preface the paper with just a few remarks. In the first place, the present work is something which is rather new; at least I am told that no one has made any direct observations on the effect of creosote or any of its constituents upon marine borers My aim in giving this paper is simply to present a few facts together with the experimental conditions under which these facts were observed. I shall not attempt to indicate at this time any practical use of the results; for I hope to do further work on the reactions of marine borers to creosote and its constituents.

The borer with which I worked enters the wood when so minute that one can see it well only with a microscope. Consequently, it would have been an exceedingly tedious, if not an impossible, task to obtain toxicity results on the embryonic borer. So my work was necessarily carried on with adult borers. I have made an attempt, however, to explain in the paper why I believe the results with the adults will apply equally well to the embryos.

My experiments were made on only one type of marine borer—a mollusc, Xylotrya gouldi. I have not worked thus far with the crustacean borer, Limnoria.

I have had a few lantern slides made to show the type of animal the Xylotrya is, how it enters wood, how it undergoes a metamorphosis and so on. (See illustrations in Dr. Shackell's paper.)

THE COMPARATIVE TOXICITY OF COAL TAR CREOSOTE AND CREOSOTE DISTILLATES AND OF INDIVIDUAL CONSTITUENTS FOR THE MARINE WOOD BORER, XYLOTRYA.†

By L. F. Shackell, M. D.

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The present investigation is an outgrowth of Project 120 of the U. S. Forest Products Laboratory. Project 120 was begun in 1910, and was designed to test "the efficiency of various constituents of coal-tar creosote in protecting piling." The results of this project to date have been published by Mr. C. H. Teesdale,* and will be referred to in part later in this paper.

*Engineering Record, Sept. 12, 1914.

†The author's study of creosote toxicity was made for the Bureau of Fisheries; materials tested were furnished by the Forest Products Laboratory, and results published by permission of the Commissioner of Fisheries.

Fig. 1.

Fig. 1 is a photograph of a typical small wharf on the North Carolina coast. Three of these untreated piles have been eaten down to spindles through the combined attacks of Xylotrya and Limnoria.

The experimental work embodied in this paper was carried on at the Marine Biological Station of the U. S. Bureau of Fisheries, Beaufort, North Carolina, from July 15 to September 15, 1914.

The writer desires to make hearty acknowledgment of the great help that he has received in various ways from members of the Bureau of Fisheries and of the Forest Products Laboratory.

Xylotrya.

The waters around Beaufort are infested with three genera of molluscan wood borers—Pholas, Teredo and Xylotrya. The last, Xylotrya gouldi, greatly outnumbers the others, and has therefore been used in the present study. A few characteristics of this borer, relevant to the experiments which were made, are given to facilitate an understanding of the results obtained.

Xylotrya enters a piece of wood while still a very minute, bivalve embryo. Once in the wood, this embryo, which has hitherto greatly resembled a microscopic clam, now undergoes a remarkable metamorphosis—the bivalve shell becomes modified to form the boring apparatus, the surface being covered with rows of toothlike protuberances much like a rasp. The body of the borer becomes elongated in proportion to its boring activity; but the posterior end always remains at the site of original entry. From this posterior end project two sensitive muscular tubes, the siphons, which serve not only for the circulation within the

borer of sea-water with its suspended food materials, but also for the ejection of macerated wood; for Xylotrya swallows through a wide pharynx at the anterior end all the wood that it excavates, and this wood must pass through the alimentary canal before it can be ejected. The opening of the shorter or inhalant siphon is fringed with a number of extremely sensitive tentacles. In Xylotrya the longer or exhalant siphon is not provided with tentacles. When necessary the siphons can be withdrawn into the burrow, and the hole at the surface of the wood plugged up with a pair of calcareous "pallets."

Fig. 2.

Fig. 2 is a close view of an untreated pile under an oyster factory. It shows typically the effects produced by the combined attacks of Xylotrya and Limnoria.

This ability of the borer to shut itself up within a practically water tight burrow, sometimes for several hours, made it impossible to obtain consistent results when pieces of wood containing Xylotrya were put into the creosote preparations. Before each experiment, therefore, speci-

mens of Xylotrya were carefully dissected from pine boards which had been exposed to the attacks of the borers for not more than five months. The animals were kept in sea-water until used. When lying free in sea-water Xylotrya will live 24 to 48 hours.

In general specimens were chosen which averaged an inch in length. Where there was any considerable variation in size of a number of Xylotrya, the latter were so distributed in different groups as to practically equalize any error due to this factor.

The Criteria of Toxicity.

Before considering the actual experiments it is necessary to explain somewhat the criteria of toxicity adapted for this work. It was early noted that if specimens of Xylotrya were placed in one of the creosote preparations, the most definite objective effect appeared in the siphons. The latter first became insensitive at one or both tips. This was followed by a very peculiar blistering and softening of the tips. The further extension of this degenerative process depended upon the length of time that the Xylotrya were in the poison, running often fairly sharply over the distal half of each siphon, or over the entire length of the siphons, or even in exceptional cases over the mantle or body covering, of which the siphons are specialized outgrowths. This degeneration was the most consistent and accurately observable phenomenon associated with the action of the creosote preparations; and for this reason it was made the basis of comparison in the determination of their relative toxic values.

The use of such empirical criteria as the loss of sensitiveness of the siphons or their softening and degeneration in varying degrees would scarcely seem to furnish a sufficient basis for the broad conclusions to be drawn later. This criticism is to be met by the following arguments:

First, observation showed that when the siphons in a given specimen were degenerated to any marked degree, the animal itself died within a few hours.

Second, the toxic constituents of coal tar creosote, from the viewpoint of the pharmacologist, are general protoplasmic poisons; that is they kill all cells with which they come in contact in sufficient concentration. In man and in the higher mammals it is true that death by acute carbolic acid poisoning results from paralysis of certain vital functions in the central nervous system, but only because carbolic acid, being poisonous for all cells, exerts its primary action on that system in which the cells are the most delicate. But in the case of such a small and simply organized form as Xylotrya, made up as it is of thin and readily permeable tissues, a general poison will in all probability exert a virtually simultaneous action on all of its tissues. In fact, if the value of creosote as a preservative rests primarily on its toxic quality, we may

Fig. 3.

Fig. 3 is a photograph of an adult Xylotrya. At the upper right are shown the boring shells at the "head" end of the animal. These boring shells, together with the feather-like "pallets" at the posterior end of the animal, are the only calcareous structures which make up the body of Xylotrya. The remainder of the body is extremely soft and delicate and is protected from injury by the wooden burrow in which the adult lives. The two tubes seen near the pallets are terminal outgrowths of the mantle or body covering and are known as siphons. The shorter or fringed siphon is inspiratory or inhalant; the longer, exhalant. These siphons may be thrust out into the seawater for an inch or more through the opening into the burrow and serve to keep up the circulation of a stream of water within the body of the borer. When an enemy approaches or the tide falls below the entrance to the burrow, the siphons are withdrawn into the burrow, and the opening at the surface of the wood is plugged up by the pallets.

confidently believe that when an embryonic Xylotrya, microscopic in size, attempts to bore into a creosoted piling, its organism will be poisoned throughout without reference to any specific organ or tissue. Therefore the extent of necrosis in the siphons, due to a given creosote preparation, may be considered as a fairly accurate index of its toxicity for the entire animal.

Tests With Emulsions of Creosote and of its Distillates.

The first part of the problem was to determine the comparative toxicity of coal-tar creosote and of five fractional distillates. The creosote and the several fractions were furnished by the Forest Service, and were the same as those used in Project 120, previously mentioned.

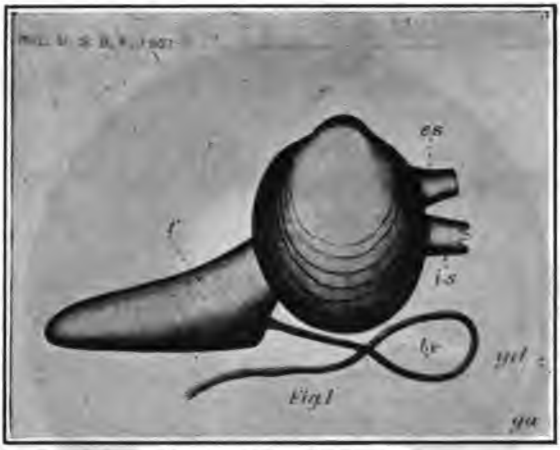

Fig. 4 (After Sigerfoos).

Fig. 4 is taken from an illustration in Prof. Sigerfoos' monograph on the natural history of the shipworms, and shows the embryo. Just before this larval Xylotrya attaches itself by a thread to a suitable piece of wood it is a free swimming organism about one-hundredth of an inch in length. In this figure *"is"* and *"es"* represent respectively the inhalant and exhalant siphons, while *"f"* shows a foot like that of a snail. The foot is used for locomotion while the embryo is seeking a suitable point of entrance into the wood; but as soon as the borer is in the wood the foot becomes altered to form a sucker-like arrangement, by means of which the animal can secure a purchase on the wood for its boring operations. The simple bivalve shells of the embryo change greatly in character with the formation of teeth on them, and thus form the boring apparatus.

The creosote is said to have been distilled from coal tar between the temperature limits of 0° and 400° Centigrade. The characters of the fractions distilled from this creosote, taken from a Forest Service report, may be summarized as follows:

Fraction	I—Light oils	up to 205° C.
"	II—Naphthalene solids	205° " 250° C.
"	III—Deal oil of golden oil	250° " 295° C.
"	IV—Anthracene solids	295° " 320° C.
"	V—Residue	above 320° C.

One per cent. emulsions of the creosote and of each fraction were made up as follows:

10 grams of the given material were triturated with 15 grams of powdered gum arabic, small quantities of sea-water being gradually added until a viscid, homogeneous mixture was obtained. This was then diluted to 1000 cubic centimeters with sea-water, and thoroughly shaken.

Very satisfactory emulsions were obtained with the creosote and with Fractions I and III; but when the emulsions of Fractions II, IV and V were allowed to stand, it was found that considerable residue

Fig. 5 (After Sigerfoos).

Fig. 5 illustrates the development of the boring apparatus. In the upper row are shown the typical bivalve shells of the embryo. Knobs soon form at the top and bottom, which serve as pivots for the rotation of the shells outward and backward. The mantle then begins to secrete rows of teeth, which are arranged in two rows perpendicular to one another. At the lower left is an illustration of the inside of one of the modified shells on which is an area outlined to show the attachment of a small muscle. The latter is attached to corresponding points inside of each shell, and serves, by its contractions, to furnish the mechanical force necessary to rotate the shells and thus rasp away the wood.

settled to the bottom of each container. The residues were crystalline in the emulsions of Fractions II and IV, and probably consisted of naphthalene in the former case and anthracene solids in the latter. Since later experiments, to be mentioned hereinafter, showed that naphthalene and anthracene possessed but slight toxicity for Xylotrya, the separation of the above mentioned residues probably did not appreciably influence the determinations of the toxic values of the emulsions. The residue settling from the emulsion of Fraction V was almost black, composed of very fine particles, and apparently carbonaceous in character.

The end sought in the use of these emulsions was the introduction into the body of the borer by means of the circulation through its siphons of a given creosote fraction without changing the relative proportions of its constituents; and this could only be done through the very fine subdivision and suspension of the material in sea-water.

The gum arabic used as the emulsifier was found by control experiments to have no action upon Xylotrya.

The method of conducting the individual experiments may be illustrated by two condensed protocols, which also indicate the striking difference in toxicity existing between Fractions I and V.

Fig. 6.

In Fig. 6 the object to the upper right is part of the calcareous lining of the forward end of a burrow. It should be stated that in a majority of cases the entire burrow of Xylotrya except that part immediately surrounding the boring shells is lined with very smooth calcareous material secreted by the mantle. If, however, a great number of borers enter a piece of wood and there is too much competition for boring space many will cease to grow and will line their burrows completely with shell. In the center of Fig. 6 are shown a pair of boring shells with everything dissected away except the muscle connecting the two shells. To the left is one of a pair of pallets. The multiple scoop-like structure is of value to enlarge the entrance to the burrow as the animal grows, so that a proper circulation of seawater may be kept up within the body of the borer.

Experiment 17—August 12.—Into each of 6 glass finger bowls were put 10 c. c. emulsion of Fraction I diluted to 250 c. c. with sea-water. At 11:00 A. M. 5 specimens put into each dish. These lots were then returned to fresh sea-water at intervals of 10, 20, 30, 40, 50 and 60 minutes respectively.

Observations at 3:00 P. M.

10′ lot—degeneration of one siphon tip in 3 specimens; degeneration of both siphon tips in 2 specimens.
20′ lot—degeneration of one siphon tip in 1 specimen; degeneration of one-half of each siphon in 4 specimens.
30′, 40′, 50′ and 60′ lots—siphons in all specimens completely degenerated.

Experiment 16—August 11.—10 c. c. emulsion Fraction V diluted to 250 c. c. with sea-water in each of 6 dishes. At 11:00 A. M. 5 X. into each dish. Returned to sea-water at intervals of 10′.

Observations at 4:30 P. M.

10′ and 20′ lots—all in good condition.
30′ lot—1 specimen normal; siphons in 3 X. slightly insensitive; beginning degeneration of one siphon tip in 1 specimen.
40′ lot—1 X. normal; siphons in one slightly and in another completely anesthetic; degeneration at tip of one siphon in each of the remaining 2 specimens.
50′ lot—siphons in 4 X. completely anesthetic; degeneration of one siphon tip in remaining specimen.
60′ lot—siphons anesthetic in 1 X.; degeneration of one siphon tip in each of 3 X., and of both siphon tips in the last.

It will be seen that Fraction I in .04% emulsion is decidedly more toxic than Fraction V in the same strength; for example, a 10-minute exposure to Fraction I is more effective than a 60-minute exposure to Fraction V.

Toxicity determinations were carried out in like manner with the emulsions of the creosote and of the remaining fractions. About two weeks later tests were again made of the creosote and of all the fractions, using fresh emulsions. The results of these later experiments confirmed the previous observations.

To summarize this series, the various emulsions are listed in the order of decreasing toxicity: Fraction I; Fraction II; Fraction III and Creosote practically equal; Fraction IV; Fraction V.

Tests With Aqueous Extracts of Creosote and Its Distillates.

It is a general rule that a drug in order to act upon a tissue must be soluble in the tissue fluids. If this rule applies to the constituents of creosote, it must follow that the poisonous effects of the creosote emulsions were due only to those constituents which were at all soluble in sea-water or in the tissue fluids of Xylotrya. To test out this point, aqueous preparations of the creosote and of each fraction were made as follows:

Two grams of the material were triturated with 15 grams of purified talc until a homogeneous, granular powder was obtained. 50 c c. of sea-water were mixed with this, and the whole thrown on dry absorbent cotton in a funnel. The residue on the filter was washed with successive portions of sea-water, 10-15 c. c. each, until the filtrate and washings totaled 200 c. c. The resulting liquid, which was perfectly clear in every case, thus represented for each 100 c. c. the water soluble constituents obtainable from 1 gram of material.

Comparative tests were made with these aqueous solutions when diluted 25 times as in the above cited emulsion experiments. The results for creosote and Fraction I are illustrated by the following protocols:

Fig. 7..

In Fig. 7 the upper worm is a specimen of Xylotrya, and the lower one of Teredo. An important point of distinction is in the pallets. It can be seen that there is no essential difference between the two forms—at least as far as wood-preservation is concerned. Between the two boring shells of the Teredo can be seen the modified foot of the embryo, used now as a sucking mechanism so that the boring shells may be held firmly against the wood. In the center is another view of the boring shells shown in Fig. 6. Within the shells the muscle can be seen to cross.

Experiment 22—August 22.—10 c. c. of the 1% aqueous solution of creosote diluted with sea-water to 250 c. c. put into each of 6 dishes. At 1:30 P. M. 3X in each dish. Lots returned to sea-water at usual 10′ intervals. At 4:30 P. M. all the specimens were in good condition.

Experiment 23—August 22.—Run at same time and in same manner as preceding experiment, except that 1% aqueous solution of Fraction I was used. At 4:30 P. M. the lots run from 10′ to 50′, inclusive, were all in good condition. Of the 60′ lot 2 specimens were apparently normal; in the third, one siphon was rather insensitive. (Cf. Expt. 17).

These two experiments showed that the clear, 1% aqueous extracts were not nearly as toxic when diluted 25 times as were the 1% emulsions similarly diluted. This apparent inconsistency is readily explained, however, by the assumption that the dilutions of the emulsions were only dilutions in a limited sense, and that in reality the added sea-water served mainly to bring into solution such substances in the

Fig. 8.

Fig. 8 shows a fence of untreated pine boards put down in a shallow curve near Beaufort, N. C., in February. The photograph was taken the following July. The boards in this fence furnished nearly all of the borers used in the creosote toxicity work.

creosote oils as were present in excess of the amounts necessary to saturate the sea-water used in making up the original emulsions.

Further experiments with the undiluted aqueous extracts of creosote and of Fractions I and V showed that the same order of toxicity obtained as of the emulsions, namely, that Fraction I was by far the most toxic, and that the creosote was more toxic than Fraction V.

The Effect of Volatilization on Toxicity.

The high toxicity of Fraction I is especially interesting in view of recent observations published by C. H. Teesdale (1), who found that experimental pilings, injected with 18-pound of Fraction I per cubic foot, lost by volatilization in a two-months' seasoning following the treatment practically 35% of the weight of the injected fraction. Furthermore, four of such treated pilings, all of one series installed at Pensacola, Fla., were severely attacked in 13 months by Xylotrya (2).

These facts suggested experiments to determine to what extent the loss of the more volatile constituents would affect the toxicity of creosote and its fractions. For this purpose the Creosote and Fractions I and III were used.

1. Forest Service Circular, 188.
2. Engineering Record, Sept. 12, 1914

Four Petri dishes were weighed empty. Into each of these creosote was poured to a depth of about 3 millimeters, the contents of the dishes weighing 132.2 grams. These dishes were exposed for 10 days directly to the sun and wind. The loss in weight was 39.6 grams, about 30%. In the same manner 156.3 grams of Fraction I lost 125 grams, about 80%; and 134.3 grams of Fraction III lost 33.3 grams, or nearly 25%.

One per cent. emulsions were made of each of these residues, and toxicity determinations were carried out as previously described. The results of one experiment are given below:

Experiment 38—August 29.—10 c. c. 1% emulsion volatilized Fraction I diluted with sea-water to 250 c. c. in each of 6 dishes. 5 X. in each dish at 1:00 P. M. Lots returned to fresh sea-water at usual 10′ intervals.

Observations at 4:00 P. M.

10′ and 20′ lots—all X. in good condition.
30′ lot—siphons in 1 X. slightly insensitive; in remaining 4 X. degeneration at tips of both siphons.
40′ lot—degeneration of both siphon tips in 2 X.; degeneration of one-half of the siphons in 2 X.; and practically complete degeneration of the siphons in the last.
50′ lot—degeneration of one-half of each siphon in 1 X.; degeneration of both siphons practically complete in remaining 4 X.
60′ lot—results practically the same as with the 50′ lot.

A comparison of these results with those of Experiment 17 above shows that the volatilization of Fraction I definitely lessened its toxicity for Xylotrya, despite the fact that the non-volatile constituents were necessarily in more concentrated suspension in the emulsion of the residue than in that of the original Fraction I.

Lessened toxicity as compared with the original oil was also shown by the residues of the creosote and of Fraction III; though the relative losses of toxicity of the latter two were not as great as in the case of Fraction I. In fact, the diminished toxicity seemed in each case to be roughly proportional to the percentage of volatile material in each oil.

We may conclude, then, that certain constituents of creosote, volatile at ordinary summer temperature, are toxic for Xylotrya.

Toxicity of the Light Oils.

It was assumed that the volatile portion of Fraction I and possibly of the other oils consisted mainly of hydrocarbon oils such as benzene and its congeners. The question naturally arose whether these light oils were not toxic. The following experiment was, therefore, made:

5 c. c. of purified xylol were thoroughly shaken in a separatory flask with 500 c. c. of sea-water. Very little of the xylol could have gone into solution, for the greater portion rapidly formed a layer above

the sea-water when the shaking was stopped. The aqueous layer became perfectly clear on standing over night. This was drawn off, and its toxicity determined as follows:

> *Experiment 55—September 12.*—30 c. c. of the sea-water saturated with xylol put into each of 6 Stender dishes. 4 X. in each dish at 1:30 P. M. Lots returned to fresh sea-water at usual 10′ intervals.

Observations at 5:30 P. M.

10′ lot—one siphon tip degenerated in each of 3 X.; degeneration of both siphons for about one-half their length in the last specimen.
20′ lot—practically the same as the 10′ lot.
30′ lot—degeneration of siphon tips in 2 X.; degeneration of siphons for one-half their length in remaining 2 specimens.
40′ lot—practically the same as the 30′ lot.
50′ and 60′ lots—degeneration of siphons practically complete in all the specimens.

It is interesting to note that these results as a whole are much like those obtained with the emulsion of Fraction I. (Cf. Expt. 17.)

We may assume, then, that the light oils of creosote are very toxic for Xylotrya.

Tests with Naphthalene and Anthracene.

Since naphthalene and anthracene form such a large proportion of coal-tar creosote, the determination of their toxicity becomes a point of great practical importance. Without going into the details of the numerous experiments made to determine this point, we may say that naphthalene and anthracene are only very slightly if at all toxic for Xylotrya This was evidenced in two ways: first, by the fact that specimens kept for an hour in a very turbid suspension of either of these substances carried on normal rhythmic siphon movements; and second, by the fact that masses of crystals could be seen to issue from the exhalant siphons when these same borers were transferred from the suspensions to fresh sea-water. The only difference noted between naphthalene and anthracene was that the former caused occasional spasmodic movements of the siphons, but did not alter their sensitiveness; whereas the borers showed apparently no reaction to suspensions of anthracene.

These results with naphthalene are in line with previous observations of C. H. Teesdale, who reports in a publication cited above that "Napthalene, when used by itself, did not prevent attack by borers."

Toxicity of the Tar Acids.

The remaining important constituents of creosote to be considered are the tar acids, consisting of carbolic acid and its homologues—the

Fig. 9.
Fig. 9 is a photograph of borers freshly dissected from untreated wood, and later used in experiments with creosote.

cresols, xylenols, naphthols, etc. Of these phenol, cresol and alphanaphthol were used for the toxicity determinations.

A saturated solution of recrystallized alphanaphthol in sea-water—approximately 0.1%—was found to kill the majority of Xylotrya exposed to its action for 10 minutes, and to kill all specimens exposed for 20 minutes. On standing for some time this solution of alphanaphthol, which was at first colorless, changed to a dark amethyst color. This change in color was shown not to affect its toxic action.

One per cent solutions of cresol (U. S. P.) and of crystallized phenol were made up in sea-water. This strength of each was found to kill Xylotrya in one to three minutes. When the solutions were diluted, however, to a concentration of 0.1%—approximating that of the saturated solution of alphanaphthol—it was found that the cresol and phenol were considerably less toxic than the alphanaphthol; but that the cresol was still considerably more toxic than the phenol. For example, all specimens of Xylotrya were killed by an exposure of one hour to 0.1% cresol; whereas the same length of exposure to 0.1% phenol produced only slight anesthesia of the siphons.

Of especial interest in connection with the high toxicity of alphanaphthol is the fact that it is manufactured at relatively low cost from the abundant but practically non-toxic naphthalene.

A discussion of the practical applications of these results would be necessarily speculative; and it is, therefore, omitted. The writer hopes, however, to continue the present study.

Summary.

1. The toxicity of creosote fractions diminishes with rise of boiling point; the toxicity of creosote itself lies between that of the lowest and highest boiling fraction.

2. The loss of volatile constituents reduces the toxicity of creosote and of its fractions.

3. The light oils of creosote are very toxic even in the extremely slight proportions in which they are soluble in sea-water.

4. Naphthalene and anthracene are practically non-toxic for Xylotrya.

5. The tar acids are extremely toxic for Xylotrya, alphanaphthol being many times more poisonous than phenol.

THE PRESIDENT: This is a most delightful scientific discussion of the troubles that we have to meet, and we want to heartily thank Dr. Shackell for this independent investigation he has carried on, and we hope he will continue his investigation during another year. We have another paper on the subject of treated piling, and I was going to say that we would delay the discussion on this paper until morning, but the Doctor says he is compelled to be out of town and I am going to give just a few moments to the discussion of this paper.

MR. M. K. TRUMBULL: Mr. President, may I ask the Doctor just one question? How many individual borers were observed in reaching the results from which your conclusions were drawn?

DR. L. F. SHACKELL: I cannot recall the exact figures, but there were at least 700, and possibly nearer 1,000 borers. (A later count showed that over 1,080 specimens of Xylotrya had been used in the toxicity experiment.)

MR. EDW. F. PADDOCK: In regard to this series of tests, while they are very interesting and do, to a great extent, show us the effect of the preservative on these animals, in view of the fact that timber preservation is a treatment of timber rather than the water surrounding it, I would suggest that in future work the Doctor subject the specimens of treated wood to the action of the borer. In other words, while the preservative might affect the borer if it were immersed, at the same time in actual practice you will never immerse the borer in the preservative. In other words, it is quite possible that it might not affect the borer at all. I would suggest such tests as these simply as a confirmation of his work.

MR. C. H. TEESDALE: There are numerous instances where the creosote treatment of piling has given excellent results in rendering timber resistant to the attack of the Teredo or Xylotrya. There are also many cases where such timber has not lasted as long as it was expected to. The investigations of the Bureau of Fisheries and of the Forest Service were instituted with the object of obtaining information on the action of these borers which would enable us to possibly make improvements in the specification for treated piling. Dr. Shackell's investigation was started primarily with the object of determining the physical effect of the preservative on the borer. In other words, what is its physiological action when it destroys their life? In the case of the Xylotrya he has gone further than this and has obtained data on the relative toxicity of the several constituents of creosote. His results are increased in value, because we have data on several of the oils which he used after they have been impregnated into the wood. (See "Engineering Record," Sept. 12, 1914.) Dr. Shackell's results indicate that Fraction I was most toxic, while Fraction V was the least toxic of the five fractions used. Service tests on piles treated with these fractions have indicated that the order of the efficiency in degree of protection obtained is exactly reversed. The specimens treated with Fraction V were almost untouched by the borers, while those treated with Fraction I were very severely attacked.

These data, therefore, indicate first, that the important toxic qualities of Fraction I disappeared from the wood, and secondly, that the low toxic properties of Fraction V are still apparently sufficient to prevent attack as long as these properties can be retained in the wood. The prime consideration, therefore, appears to be a preservative which will remain in the wood indefinitely without losing its toxic properties. It is quite possible that some of the failures of creosoted piling are caused by the loss of important constituents, either by evaporation or by leaching from the wood. Given a thorough knowledge of the action and properties of preservatives for marine work, it is quite possible that a preservative will be evolved which, while being highly toxic, will also remain indefinitely in the wood. With such a preservative it should be possible to use a much lower absorption and thus lower the cost of treatment, as well as increasing the resistance of the treated timber to the borers.

DR. H. VON SCHRENK: Mr. President, I would like to ask the Doctor a question. I may have misunderstood. I would like to ask the Doctor whether in his researches he reversed the order of procedure with regard to toxicity by removing certain of the fractions from the oil and testing the remainder as far as the toxicity is concerned? In other words, whether he removed the naphthalene from a sample of oil and observed what effect the remaining oil without the naphthalene produced.

DR. L. F. SHACKELL: I never did anything along that line; but certain inferences may be drawn from the results of my experiments. For instance Fraction II contained a large proportion of naphthalene; yet this fraction was very toxic, whereas the naphthalene alone was found to be non-toxic. The non-naphthalene portion, consisting mainly of light oils and tar acids, must have been responsible for the toxic quality of Fraction II. From my experiments I gained the impression that the diminution in toxicity with rise in boiling point was mainly due to decreasing quantities of light oils in the consecutive fractions.

DR. H. VON SCHRENK: My reason for asking the question was to try to harmonize results. Mr. Teesdale just spoke of and Dr. Shackell has spoken of the actual practice. We are puzzled by the apparent conflict of results which were obtained by analysis in the laboratory and the results of an exceedingly valuable character that the Doctor has given us. When we analyze a pile that has been in service 15 years in absolutely perfect condition throughout its entire length with no attacks of the animals whatever, we apparently get very little concordant results with the results given by selecting individual fractions. I think the more we study the creosote oil question the less we seem to appreciate thoroughly what the chemical relation speaking from a purely organic chemical standpoint, are of those compounds when they are in the wood. I have oftentimes wondered whether it would not be a desirable thing to reverse the order of procedure, because that is exactly what happens in the wood. Some of the compounds leave those piles and certain compounds remain in the wood fibers, and it is those things that, after all, do the protecting or not, as the case may be.

MR. T. G. TOWNSEND: Mr. President—

THE PRESIDENT: I wonder if I could ask your indulgence to pass this over until the morning. We are going to have a discussion of Mr. Christian's paper on this same subject. I wonder if we could not postpone this until that time, so we can call on Committee No 2. I promised to give them a hearing at 4 o'clock.

MR. T. G. TOWNSEND: That is satisfactory to me.

THE PRESIDENT: Will Committee No. 2 come forward and present their report?

MR. E. A. STERLING: Mr. President and gentlemen, in submitting the report of Committee No. 2 on Specifications for the Purchase and Preservation of Treatable Timber, it is not necessary to explain that the subject is a very broad and diversified one. Before proceeding with the report proper I want to make a few explanations on behalf of the committee.

First of all, let me say that in submitting the report in its present form we had in mind primarily to meet the demand or need for summarized information by the consumer, the amateur in wood-preserva-

tion and the inexperienced man who is perhaps going into this subject for the first time. We have not attempted to present a report for the benefit of the man who knows the business thoroughly from end to end. In presenting the report in this form we have compiled and summarized the points which we believe have a sound basis in established practice. It naturally follows, however, that some of these points are matters of dispute and the question as to whether they are right or wrong will, no doubt, come up on the floor of the convention. Even in our committee there has been some disagreement on minor points; in fact, I want to explain at this point that one member of our committee, Mr. C. P. Winslow, has preferred not to sign the report for the reason that he is not in accord and cannot accept some of the statements which we have included.

In further consideration of the general character of the report, let me say that we feel that this subject should be carried on. We anticipate that since it is a standing committee the investigations will be continued, hence many of the suggestions offered can be considered by a committee later than on the floor of the convention. Let me repeat again that we are trying to present here basic arguments and basic deductions for future consideration, elaboration and improvement.

Proceeding with the report I will summarize briefly, and not attempt to read it, because to read it all would take too much of your time. In interpreting the instructions of the Executive Committee we prepared a general outline, which covers first the purchase of treatable wood and its preparation, particularly the seasoning process. Having seasoned the timber and prepared it for treatment the next logical step is applying the preservatives by various methods and using various preservatives for this purpose. Having covered these essential points we have tried to summarize some of the fundamental principles which seem to have an established basis.

Under Topic E, which is a discussion of regional conditions, we have perhaps opened up a new field, this being important for the simple reason that climatic, regional and local conditions largely determine the way wood should be treated and the results that will be gotten; we have, therefore, arbitrarily and tentatively selected these five broad general regional conditions under which timber is used

Under Topic A, the purchase of treatable wood and the subheading of structural timbers, I will skip to the matter of general specifications and say that we have tried to use as far as possible existing specifications which can be applied with modification or without modification to wood which is to be treated. In that connection it might be suggested that since there are at least three associations working on this same question of specification for treatable wood, namely, the American Railway Engineering Association, the American Society for Testing Materials and this Association, it might be a good plan

to have a joint committee from these various organizations to finally decide on something definite which can be accepted by all.

After stating that we consider the specifications of the American Railway Engineering Association as to general requirements the best which exist, we go into some detail in the fine type regarding the species of southern pine. The proposed specifications covering density having been suggested, I want to explain that under No. 2 structural grade we have modified the specifications as considered originally by the old yellow pine association. There is a question whether a 50 per cent. sap limitation should be included and this is a point which naturally will come up for discussion.

Passing on to track ties we have done practically the same thing as under structural timbers, namely, suggested the use of existing specifications as far as they will apply and have gone into some little detail on matters of species and sap requirements. Under 3, Piles, there was considerable discussion as to what sap limitations or restrictions or requirements should be stated. It is probably felt that under ordinary conditions piles should have enough sap wood or at least enough treatable wood, so that the treatment will give protection under the local conditions. Perhaps the most valuable suggestion here is that the density requirements which have been considerd for structural material might be considered for piles. Preparing timber for treatment is an important subject, but since you have the printed paper before you it is not necessary to read any of it. I might refer particularly, however, to the paragraph on moisture determination. One of the reports submitted yesterday included the same subject, and I noticed that some difference in the percentage of permissible moisture appears between the two reports.

When we come to the sub-heading "C," "Specification for Preservatives and General Methods of Application," we reach a broad and, perhaps, a dangerous subject. In stating that coal-tar creosote possesses practically all the essential requirements for an ideal preservative I think that we are on entirely safe ground. Proceeding, however, from this fundamental basis to the various questions of economy and specific local requirements, we come to sub-considerations, if you wish to call them such, which lead to two established forms of applying or injecting creosote, the full cell and empty cell treatment. The text under these two headings is self-explanatory.

Following the consideration of creosote as perhaps the general preservative under the conditions here stated, we come to chloride of zinc, which is probably equal in importance and which, as we say, deserves full consideration under specific conditions. Here again the question of cost and local requirements enter largely into the matter.

Under 3, which includes the compounds of creosote and zinc chloride, we have considered that the use of the two fundamental preserva-

tives was the safest basis on which we could make recommendations. The evidence regarding what either of the preservatives will do singly is fairly complete. The evidence as to the effectiveness of the two used in combination is also practically complete, but we have considered it advisable to confine our fundamental recommendations to the two primary preservatives.

Under 4 the question of a coal-tar creosote mixture is considered. We have confined ourselves practically to referring to the recommendations of the American Railway Engineering Association on this subject, and in doing so we feel that we are following the work of a committee which has given very careful consideration to the matter. It is referred to here for the reason that the creosote coal-tar solution is in general use and is of great economic importance at the present time. Under the head of "D," "Summary of Fundamental Principles," I will not attempt to read any particular points, but want to explain that our Committee at a meeting last evening decided to eliminate the paragraph entirely regarding the minimum duration of treatment. If you will permit me to turn back again to the question of refined coal-tar, I would like to say that the suggested maximum 30 per cent. is tentative, and I think we should follow this year's recommendations of the American Railway Engineering Association on this point. We have merely tried to discuss this very broad and important subject in a rather general way. It is quite generally realized, and less generally practiced, that certain things should be done to meet certain conditions. That is all we have tried to do here and to discuss under the headings which were outlined in the earlier part of the report the particular treatment and the particular preservative which it seems reasonable to assume is the best under given conditions.

In conclusion I may say on behalf of the Committee that there are a great many things which should be considered very carefully in the future, and many points which need further elaboration. There are new points to be brought up and discussed, and a committee could keep occupied for a number of years.

REPORT OF COMMITTEE ON SPECIFICATIONS FOR THE PURCHASE AND PRESERVATION OF TREATABLE TIMBER.

To the Members of the American Wood Preservers' Association:

The instructions of the Executive Committee for this year's work of Standing Committee No. 2 are understood to cover essentially the species and character of timber for treatment, and the kind of preservative and general methods of application. A review of treating

methods and a statement of fundamental principles is suggested, with a summarizing into specifications as far as possible.

The following general outline we believe accords with the instructions of the Executive Committee, and covers the fundamentals under the subject heading of Committee No. 2:

A. The purchase of treatable woods, with sub-heads according to uses and service requirements.

B. Preparing timber for treatment, with special reference to seasoning.

C. Preservatives and general methods of application, in accordance with the kinds of wood, preparation for treatment, and uses.

D. Summary of the fundamental principles underlying efficient treatment of any kind, with specifications for generally accepted procedure.

E. Discussion of regional considerations based on—

Region I.—Abundant Timber and Warm Moist Climate.
The Gulf Region, Lower Mississippi Valley and Atlantic Coastal Plain, south of where severe winter conditions prevail.

Region II.—Abundant Timber and Dry Climate.
The timber region in Arizona and New Mexico, and northward along the eastern slopes of the Rocky, Sierra Nevada and Cascade Mountains.

Region III.—The Moist Central Hardwood and Northern Mixed Forest.
The hardwood belt of the Central States and Mississippi Valley, and the mixed conifers and hardwoods of the Lake, Middle and New England States.

Region IV.—The Moist Heavily Timbered Sections of the Pacific Coast.

Region V.—Treeless Plains and Prairies.
Ranging from arid to semi-humid.

A—The Purchase of Treatable Woods.

This topic is the logical first consideration, since upon the kind and character of the timber purchased largely depends the methods of treatment and the ultimate value of the material. For the present this topic is limited to structural timber, track ties, and piling. Paving blocks are under consideration by Committee No. 3; while poles, posts, mine timbers and other classes of material are left for later consideration.

(1) *Structural Timbers:*

The fundamental requirements of structural timbers for treatment are strength, and capacity for treatment to an extent which will insure protection against decay on all exposed surfaces. A penetration of ½-inch on the heart faces may be recommended as a safe minimum on structures above ground.

The strength requirement is determined by the species, and is further dependent upon the soundness, density of the wood, frequency,

size and location of the knots, the extent, character and location of shakes and checks, and the character of the grain. Treatability in most woods is determined by the proportion and relation of heartwood and sapwood, with exceptions in the case of heartwood which takes treatment. Where strength is required, not only the defects which might reduce the strength, but also the quality as determined by density should be specified; but where strength is not an essential only the soundness of the timber and the sapwood requirements as determining penetrability need be considered.

The Committee has compiled the latest and most acceptable specifications covering defects in structural timber, and has also considered specifications as to quality. The American Society for Testing Materials, and the American Railway Engineering Association are also working on specifications for treatable timber, and since uniformity in the ultimate specifications is desirable, the Committee is not presenting its conclusions at the present time, but advises co-operation along this line with other organizations. What is presented below is intended to represent the most acceptable present practice as to quality requirements, and is mainly summarized from existing specifications in accordance with the references given.

The new grading rules approved by the Directors of the Yellow Pine Manufacturers' Association, in May, 1914, come the nearest to meeting the requirements for treatable yellow pine.

The specifications of the American Railway Engineering Association (1911 Edition of Manual, pages 141 to 144 inclusive) as to general requirements may be accepted for the present. The heartwood requirements, however, should be modified to admit more sapwood, since sapwood of equal moisture content and density is as strong, and after treatment as valuable for ordinary structural purposes as heartwood.

The kinds of wood which it is considered good practice to treat for structural purposes, and the suggested modifications from the American Railway Engineering Association specifications are as follows:

(a) *Southern Yellow Pine.*—Includes under recognized classification of botanical species, longleaf pine (Pinus palustris), shortleaf pine (Pinus echinata), loblolly pine (Pinus taeda), Cuban pine (Pinus heterophylla), and less commonly, pitch pine (Pinus rigida), pond pine (Pinus seretina), and table mountain pine (Pinus pungens); also under commercial designations North Carolina pine, Georgia pine.

For posts, caps, sills, stringers and other structural purposes where strength is required, the following new grading rules mentioned above are recommended:

No. 1 structural grade.—All timber shall be sound and sawed to standard sizes; dense, free from such defects as ring shake showing on the faces, injurious cross grain, unsound knots and decay.

"Dense" in the above is defined as showing: On cross section an average of not less than eight (8) growth rings per inch, measured over the third, fourth and fifth inches, on a radial line from pitch to circumference, containing in the greater number of rings, one-quarter or more of summer woods or, may have an average

of six (6) or seven (7) rings as above, provided in the greater number of rings one-third or more of the ring is summer wood, or wider ringed material if in the greater number of rings one-half of more of the ring is summer wood as above, and must show a sharp contrast in color between spring wood and summer wood.

For purposes where strength is not essential it is safe to purchase:

No. 2 structural grade.—This grade conforms with Grade 1 above, except that the density requirements are modified. A suggested modification is: Timber having six (6) rings or over per inch shall have one-fourth summer wood, and material with less than six (6) rings per inch one-third summer wood.

Under the old grading rules may be specified: Sound and square edge; sap no objection.

(*b*) *Western Yellow Pine.*—Includes under a botanical classification of species, bull pine (Pinus ponderosa), and Jeffery pine (Pinus Jefferyi).

For general structural purposes specify:

Standard grade with not over fifty (50%) per cent. sap wood.

It is also suggested that the proposed new grading rules for southern yellow pine be adopted as far as practical.

(c) *Douglas Fir.*—Only one botanical species (Pseudotsuga taxifolia). Commercially is most commonly designated as red fir; also as Oregon pine and Douglas spruce; and on the basis of color and age characterized as red and yellow fir.

For general structural purposes specify as to quality and soundness in accordance with the 1911 Manual of the American Railway Engineering Association (pages 143-144), but encouraging rather than restricting sapwood. Consider also the factor of density as discussed for yellow pine.

Also consider local conditions of growth as influencing penetrability For example, inland fir on river slopes and in protected situations, is considered more satisfactory for treatment than tide-water timber.

(*d*) *Red Oak.*—Not commonly treated for structural use. Includes the various botanical species commercially grouped as "red oak." Purchase according to grading rules of the National Hardwood Lumber Association. No sapwood nor density restrictions necessary.

(*e*) *Refractory Conifers.* (*Hemlock, Spruce*).—Not commonly treated for structural use since penetration is superficial. Where used specify for size and soundness, with as much sap as possible. It is not practical nor desirable to specify density restrictions.

(2) *Track Ties:*

Under this heading are included standard cross ties, bridge ties and switch sets. The latter two are included under this head because the specifications are practically the same as for track ties, although usually purchased by board feet instead of by the piece.

The specifications of the American Railway Engineering Association (1911 Edition of Manual, pages 51 to 54 inclusive) as to size, form, and manufacture should be followed, except in regard to heartwood requirements and other modifications and additions noted below:

(*a*) *Southern Yellow Pine.*—The same botanical and commercial designations as in (a) under (1) above.

For heavy main line traffic specify not more than two (2) inches of sapwood at rail bearing points on each face.

For light or medium traffic specify not more than four (4) inches of sapwood at rail bearing points on each face.

For industrial and standing tracks, yards and branch lines of light traffic specify "sap no objection."

Where ties are to be adzed and bored before treatment and equipped with tie plates having a minimum bearing surface of fifty (50) square inches, the permissible sapwood limits specified in inches above may be increased to four (4) and six (6) inches respectively.

All southern yellow pine ties with sap restrictions should be cut with the heart as nearly in the center as possible. Ties cut from dead trees should be accepted if they meet the general requirements of size and soundness.

(*b*) *Western Yellow Pine.*—Same botanical and commercial designations as (b) under (1) above, with, in some regions, the addition of lodge-pole pine (Pinus contorta) and jack pine Pinus divaricata), and on the Pacific coast occasionally knob-cone pine (Pinus attenuata).

Specify the same sap restrictions as for southern yellow pine; strictly sap ties not commonly obtainable.

(*c*) *Douglas Fir.*—Same botanical and commercial designations as (c) under (1) above

Pole or Slab Sawed Ties:

Should be of specified size with ends sawed off square, hewed or sawed on two sides straight and true to an even thickness throughout and free from bark. Should be made from sound, live, or freshly fire killed timber taken out of wind, and should be free from splits, shakes or unsound knots and score hacks.

Sawed Ties:

For sawed ties the same general specifications as above. Sound knots not to exceed 2½ inches in diameter allowed. Wane edges over one (1) inch on face should not be allowed.

Neither sawed nor pole ties made from white fir nor from smooth barked coarse grained second growth fir timber, nor from coarse grained hearts of large logs should be accepted.

(*d*) *Hemlock, Tamarack and Spruce.*—These three woods are resistant to preservatives, especially creosote, but large quantities are treated where other woods are not available. The hemlock is represented by two species, Eastern hemlock (Tsuga canadensis) and Western hemlock (Tsuga heterophylla). Tamarack is known variously as larch and hackmatack, the Eastern species being (Larix Americana) and the Western (Larix occidentalis). The spruce referred to is mainly the eastern red or black spruce (Picea rubens or Pinus mariana).

Specify the same general requirements as to soundness and defects as for fir. In western tamarack special attention should be given to avoid pitch seams which are very common and exceedingly detrimental.

(*e*) *Red Oak.*—Includes the various species in the red or black oak sub-family, which is distinguished by the pointed lobes of the leaves and acorns maturing at end of second season; also by the open porus nature of the wood, with the prominent pores in the spring wood in three to six rows as compared with one or two rows in white oak. The principal commercial species are red oak (Quercus rubra), pin oak (Quercus palustris), black oak (several species), scarlet oak (Quercus coccinea,) yellow bark oak (Quercus velutina), Spanish oak (Quercus digitata), shingle oak (Quercus imbricata).

Specify for size and soundness, and the other requirements will take care of themselves.

(*f*) *Beech.*—Represented by only botanical species (Fagus Americana), with a local separation into red and white beech. Inspect closely for dry rot.

(*g*) *Birches.*—Includes black or cherry birch (Betula lenta), yellow or gray birch (Betula lutea), red or river birch (Betula nigra), white birch (Betula populifolia) and paper birch (Betula papyrifer).

Specify for size and soundness.

(*h*) *Maples.*—Includes sugar or hard maple (Acer saccharium), silver or soft maple (Acer saccharinum), red maple, (Acer rubrum).

Specify for size and soundness.

(*i*) *Gums.*—Includes red or sweet gum (Liquidambar styrachiflua), cotton or tupelo gum (Nyssa aquatica) and black gum (Nyssa sylvatica). These are known under additional names

of sour gum, water or white gum, pepperidge, satin walnut and liquidamber.

Specify size and soundness and inspect closely for the latter.

(j) *Miscellaneous Hardwoods.*—These include elm, sycamore, ash, etc., and since there is little confusion in names, may be purchased under the local designations.

It is recommended that as far as possible, the sappy species such as beech, birch, gum and maple be restricted to winter cut material, on account of the prevalence of sap-rot.

(3) *Piles:*

The selection and purchase of piles for treatment should take into consideration their ultimate use, whether in salt or fresh water, for land foundation or marine work, and particularly whether subject to marine borers. The sapwood requirements, especially when the heartwood is resistant to treatment, should be based directly on service considerations.

For the present it is recommended that the specifications of the American Railway Engineering Association (1911 Manual, pages 145-146) be followed as to dimensions and defects. Modifications as to sapwood requirements are suggested as follows:

(a) *Southern and Western Yellow Pine.*—Specify a minimum of two and one-half (2½) inches of sapwood on piles to be used where marine borers are active, and one (1) inch under other conditions.

Where strength is a factor consideration may be given to the proposed density requirements for structural timber, modified for piles as follows: The percentage of summer wood shall be not less than one-third (⅓) as measured on the growth rings in the third, fourth and fifth inches from the center at the butt end.

(b) *Douglas Fir.*—Specify second growth or other timber with a minimum of one inch of sapwood.

(c) *Red Oak.*—No sap requirements necessary.

(d) *Tamarack.*—Not used to any extent, but of probable value, and should be tried out where available.

Square piles should not be accepted for treatment.

B—Preparing Timber for Treatment.

Preparing timber for treatment embodies mainly the various steps in the seasoning process, and is a very important factor in determining the ultimate value of the treated material. Owing to the wide diversity of conditions and the individual characteristics of the different woods, it is difficult to specify definitely under this heading. There are, however, certain fundamental principles which may be stated without further investigation.

Whenever conditions will permit, thoroughly air season all structural timber, track ties, piles and other material before treatment. So far as practical arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity. Pile incoming material in its proper groups or classes, separating green from seasoned or partially seasoned material, and using successive portions of the yard for the storing of green timber.

The seasoning yard should be in the open where the prevailing winds will strike it freely; should not be near any large bodies of

water, nor in a low and humid situation of any kind if it can be avoided; should have good drainage; and should be kept free from weeds and grass and decaying wood material.

All outer bark should be removed before treatment and in most cases before seasoning. Also as much of the inner bark should be removed as practical, and in no case should strips over one inch wide and six inches long be left.

Adjust the methods of piling ties and timber for seasoning to the local climatic conditions, so as to obtain maximum rapidity in seasoning without undue checking or warping. Support all piles on treated stringers and allow at least six inches of air space underneath. The alleys between the piles should be not less than five feet in the working spaces and one foot in other directions.

In a moist climate and under humid conditions, season all material in open piles, which will provide free circulation of air and exposure to the sun. Place a close slanting roof of ties over all piles. By open piles is meant the common 1x7, 1x8, or 7x2 piling system, or other arrangement which gives a minimum contact and the maximum of open space between the ties. In arid climates with low humidity, season in close piles to prevent checking and warping.

Practically all woods can be air seasoned except in low, humid locations. Gum is an exception unless air seasoned under favorable conditions. Both gum and beech should be seasoned only in very open piles and watched very carefully for dry rot. "Bluing" of sap pine during seasoning is not necessarily an indication of decay.

Ties and timber which have a tendency to check should be protected with "S" irons, or other devices. These should be applied in the seasoning yard to all sticks showing serious initial checks in order to prevent further checking during or after treatment. Red oak and beech should be watched closely in this regard.

Hardwood track ties should be given a minimum of eight (8) months' seasoning and should preferably be seasoned twelve (12) months; yellow pine if seasoned in the South, four (4) to six (6) months; hemlock, tamarack, and jack pine twelve (12) months. Over seasoning may prove detrimental with some species.

A determination of whether wood is sufficiently air seasoned for efficient treatment may be based on moisture extraction from borings which should show an average of not over twenty (20%) per cent. moisture in relation to the oven dry weight of the wood; or if the above moisture determinations cannot be made, season to a constant weight. Consideration may be given to a new Troemroid Scalometer device for determining the moisture content of wood. In some cases it is advisable to make local experiments to determine the weights at which timber

treats best. (See Bulletin 161, American Railway Engineering Association on "Air Seasoning of Timber.")

When there is not sufficient time for proper air seasoning, or in the case of piling and large dimension timbers which will not air season successfully throughout without deterioration, artificial seasoning by steaming or boiling before treatment must be resorted to. In steaming the pressure should at no time exceed twenty (20) pounds per square inch, nor the oil temperature in boiling exceed 220 degrees F. (maximum).

Insist on prompt delivery of all material to the seasoning yard, and on open piles while in the woods or on the right-of-way, the closest piling permissible being 7 x 2. Gum should not be left in the woods nor in close piles over ten days; treatable hardwoods and sap pine not over thirty days, and heart pine not over sixty days.

Douglas fir offers a special problem in seasoning. It is urged that a further study of seasoning methods and their effect on strength and penetration be made. The material reduction in strength of Douglas fir piling from steaming is demonstrated by recent tests published as Bulletin No. 168 of the American Railway Engineering Association.

C—Specifications for Preservatives and General Methods of Application.

This subject has been presented and discussed by various engineering associations, and further investigations are under way. The Committee, therefore, does not consider it expedient to suggest changes or modifications of existing specifications for preservatives or processes at the present time. There is, however, immediate need for information and recommendations covering the choice of preservatives, and of treatment in relation to the kinds of wood and its uses. This subject is complicated by the necessity of considering regional conditions, service location of treated material, and plant location. It is not possible for the Committee to fully cover this ground at present, and the suggestions which appear in this report should be considered preliminary to further investigations.

Since the 1911 Manual of the American Railway Engineering Association, pages 446 to 450, gives detailed specifications of processes, a review of these treatments here would be largely repetition. The following presentation of preliminary recommendations for recognized primary preservatives is in relation to the important question of treatment as influenced by service requirements.

(1) *Coal-Tar Creosote*:

From the standpoint of permanence and protection of wood against decay and marine borers, coal tar creosote is the best available pre-

servative for general purposes. It possesses the necessary theoretical requirements, and has stood all practical tests through many years' use under varying conditions of service and in many different kinds of material.

While the carefully drawn specifications of the American Railway Engineering Association and other organizations are desirable and should be followed wherever cost and availability permit, there is no proof that the higher grade creosote oils are necessary when timber is treated to refusal or practically so. The attainment of a high standard and the insistance upon specified fractionation, is the surest protection which the consumer can have in procuring the best quality of oil available. The question of availability and economy, however, often necessitates a modification of the strictest requirements, and at the risk of trespassing on the province of Committee No. 1, the Committee suggests under existing conditions the acceptance of Grades 2 and 3 as specified by the American Railway Engineering Association, for all general purposes for which Grade 1 oil was demanded when available. It naturally follows that the less the injection the better should be the quality of the creosote, from which it is evident that the heavy, high boiling creosote represented Grade 1 oil is preferable for empty cell treatment.

Economical considerations are quite apart from the general acceptance of creosote as the most effective preservative. This leads to methods of reducing the first cost of treatment, and we, therefore, have two general methods of applying creosote to timber as follows:

FULL CELL TREATMENT.

This form of treatment, under the name of the "Bethel" process, has been used extensively for years. It is essentially the impregnation of wood with practically all of the creosote it will hold, thereby giving the maximum protection. For many purposes this treatment is too expensive and, we, therefore, make the following recommendations for its use:

The Committee recommends the use of the full cell process for piling and other marine timbers where subject to be attack of the teredo and other marine borers, and that in such situations an injection of at least twenty (20) pounds per cubic foot, or treatment to practical refusal, should be given; while in marine and land situations where decay is the principal source of failure, treatments may range down from twenty (20) to ten (10) pounds per cubic foot by the same process.

We further recommend the full cell treatment in permanent structures not subject to mechanical wear; when conditions of moisture, climate or humidity are favorable to wood-destroying fungi, and particularly where the cost of renewals or replacement would be high.

EMPTY CELL TREATMENT.

Empty cell treatment with creosote aims to reduce materially the final retention of creosote per cubic foot, giving at the same time equal depth of penetration.

The two recognized empty cell processes, the "Rueping" and the "Lowry," base their patent features on fundamentally different means of attaining the same end. The Rueping treatment requires an initial air pressure which is held during the introduction of the creosote. and the application of the pressure necessary to force it into the wood. When the oil is withdrawn from the treating cylinders and the pressure reduced to sub-normal by a vacuum, the initial air in the wood forces out the surplus creosote. With the Lowry process, a quick high final vacuum is depended upon to recover the surplus oil. By each of these processes a maximum depth of penetration with a final retention of five (5) to eight (8) pounds of oil per cubic foot is claimed. With some species even smaller quantities of oil may be fully distributed.

With the increased cost of creosote and a shortage in supply, and the growing realization that it is entirely useless to preserve timber from decay beyond its mechanical life, empty cell treatments have rapidly grown in favor and are used by several of the largest railroad systems. While definite deductions may be drawn from theoretical consideration of the two processes and divergent opinions are held, it is not for the Committee to pass judgment, and the fact remains that both processes have received wide recognition. The essential factor entitling any empty cell process to recognition or approval is that there be an appreciable recovery usually a minimum of forty (40%) per cent. of the oil injected, and that initial penetration before recovery of the surplus be entirely through the treatable portions of the stick; that is, through the sapwood and at least superficially in the heartwood, the extent of the latter depending on the species. It should be remembered that an average of five pounds per cubic foot may mean a retention of 8 to 10 pounds per cubic foot in the treatable portions where most needed.

The Committee suggests the empty cell treatment for all track ties used in moist climates or situations, under service conditions which give a mechanical life of eleven (11) to fifteen (15) years; also for structures of limited life or subject to superficial mechanical wear, and elevated so as to be exposed mainly to the wood destroying influences of weather conditions.

In all outside situations it is recommended that a maximum injection of creosote, or sufficient to insure the penetration of all treatable wood, be required, and that not less than five (5) pounds of creosote per cubic foot be left in the treatable portions of the wood; while it is urged as a definitely specified requirements, that AT LEAST ALL OF THE SAPWOOD AND AS MUCH OF THE HEARTWOOD AS IS POSSIBLE FOR THE PARTICULAR SPECIES SHALL BE THOROUGLY IMPREGNATED, AND THE DEPTH OR EXTENT OF THE PENETRATION BE EQUAL TO THAT OF THE FULL CELL TREATMENT.

(2) *Chloride of Zinc:*

Chloride of zinc is of great importance as a preservative, and is the only mineral salt extensively used for wood preservation. It deserves full consideration in regions of low precipitation, in dry situations, and where low first cost is essential. It came into use in this country even before creosote, and has in most cases given service which fully justifies its application. While the life of zinc treated material is usually less than that of creosoted, the expense is also less, and the relation of cost to service is an important consideration. Further considerations are an ample domestic supply, ease of transportation, and practically stable prices. The efficiency of the zinc treatment depends largely on its proper application, and its use under suitable conditions. Our recommendations regarding zinc chloride are as follows:

> We recommend that where zinc chloride alone is used it be by the standard processes known as "Burnettizing" and that a full impregnation which will insure the retention of a minimum of one-half (½) pound of dry salt per cubic foot of timber be given. In stating the above minimum standard practice is followed, but the Committee suggests that under usual conditions a three quarter (¾) pound injection would be advisable.
>
> We suggest zinc chloride treatment in arid and semi-arid regions, particularly on track ties and other material with mechanical life limited to eleven (11) years; also for woods resistent to creosote. It should not be used where mechanical wear is eliminated, nor in situations where the treated timber is in permanent or intermittent contact with either stagnant or flowing water. Consideration should also be given to its use on overhead trestles and similar structures.
>
> Under usual conditions three months' seasoning after treatment is advisable.
>
> Since there are conflicting data regarding the leeching of zinc chloride from timber, and since reliable statistics regarding its value in moist climates are not available, we would strongly recommend that definite service tests be made in the Southern and Eastern states to determine the actual life of zinc treated material in humid conditions. This might well be made a function of the Association or Committee in order to insure its being done promptly and well.

(3) *Creosote-Zinc Chloride:*

The use of creosote and zinc chloride in mixture has been practiced for some years, by the Card and Allardyce methods in this country, and in Europe by the Rutger process, although now practically abandoned abroad. The most widely recognized use of this combination in America is by the "Card" treatment, whereby the creosote and chloride, since they are of different specific gravity, are emulsified

during treatment by being passed through a centrifugal pump. A two movement application of the two preservatives has also been used to a limited extent in the Allardyce process. In both cases the procedure is based on mechanical methods, and not upon a process of injection.

While evidence is at hand to indicate satisfactory service from timber treated by a combination of zinc chloride and creosote, the question has arisen as to whether the same results would not be obtained by proper treatment with straight zinc chloride, or by a light empty cell treatment with creosote. Whatever the facts, widely divergent opinions are certainly held as to the effects of creosoting as a seal, and of the coating or penetrative action of emulsified oil.

The Committee, therefore, is not able to make definite recommendations regarding this method as against or in comparison with either of the constituent preservatives, although realizing the effectiveness of the combination. For the reasons stated, the suggestions and recommendations in the report regarding preservatives and processes are confined to the two primary preservatives, creosote and zinc chloride. While the creosote-zinc chloride mixture is not specifically recommended, it is fundamentally effective because composed of the two most widely accepted preservatives. If there are situations where the mixture or emulsion is preferable to a single preservative, it should be used according to the judgment of the consumer as to its greater economy and efficiency under the local conditions.

This is another subject on which experiments and service tests should be made, with the specific aim of determining the value of the combination in comparison with the same amount of either preservative alone.

(4) *Coal-Tar Creosote Mixture*:

The Committee would refer to the 1913 Report and recommendations of the American Railway Engineering Association on this subject (Bulletin 163). It believes that the use of refined coal-tar under the restrictions specified by the American Railway Engineering Association (page 627, Bulletin 163), does not reduce the efficiency of treatment, and is particularly advisable under present conditions in order to conserve the supply of creosote. The next step is a specification for this solution. Refined coal-tar in quantities not exceeding twenty (20%) per cent. should not be considered an adulterant of creosote.

D.—Summary of Fundamental Principles.

The wood-preserving industry has so many ramifications, including lumbering, wood technology, chemistry, engineering, administrative and economic, that a statement of fundamentals covers a very broad field. Many points which may be considered fundamental have been

discussed in other parts of the Report; hence, the following will be limited mainly to additional discussions or recommendations:

Preservative treatment should be limited to kinds of wood which are not in themselves resistant to decay, thus making timber available which otherwise would be useless, and which is obtainable at low cost as compared with durable species.

The wood accepted for treatment should be of such a character as to be treated at least throughout the sapwood, and if the heartwood is not capable of treatment, it should be in itself resistant to decay.

Only sound timber, free from defects which would reduce its value for the purposes to be used, should be treated. Treatment will not cure decay nor defects of any kind.

The moisture content of the wood before treatment should be reduced, preferably by air seasoning, to not more than twenty (20) per cent. of its oven dry weight, or to a constant weight basis.

The temperature in the treating cylinder should never be raised above 260° F. in steaming, nor above 200° F. during oil immersion. In the boiling process the oil temperature may be increased to 220° F.

Wherever possible, all timber should be framed before treatment, and in lieu of this unimpregnated wood exposed by framing after treatment should be thoroughly painted with hot creosote oil.

To insure uniform bearing surface and maximum penetration under the rail seat, all ties should be bored and adzed before treatment. Although sawn ties may have a uniform surface, the boring increases the penetration at the point it is most needed.

BASE EFFICIENCY OF TREATMENT PRIMARILY ON THE EXTENT OF DISTRIBUTION OF A STATED AMOUNT OF PRESERVATIVE, RATHER THAN ON FINAL RETENTION PER CUBIC FOOT. At railroad plants and for railroad material, the recommendations of the American Railway Engineering Association (page 631), Bulletin 163) may be followed:

> "It is therefore recommended that at railroad plants the absorption be based on the treatment which will give the most complete penetration for each kind or class of timber, specifying complete penetration of the sapwood and as mucn of the heart as is possible for the particular species or charge; payment to be based on the amount of preservative used, plus operating and other charges."

In specifying the amount of creosote to be injected, use gallon as the unit for track ties, posts, cross ties, and other material of uniform size, and pounds per cubic foot for piles, poles and similar material of variable size, (page 631, Bulletin 163 of the A. R. E. Association).

Adjust the treatment, including preservative and process, as far as possible to the mechanical life and service requirements of the material.

E.—Regional Considerations.

Definite recommendations for the combination or specific application of "A", "B", "C" and "D", under regional conditions must be deferred until further data are compiled. The following brief discussion is submitted at the present time:

Region 1.—Abundant Timber and Warm Moist Climate. (Average precipitation over 40″.)

Since treatable timber, especially pine, is abundant in this region, it is comparatively cheap, and for this reason the preservatives used and the methods of application must be as economical as possible. The first choice for preservatives is coal-tar creosote because it is stable under the conditions prevailing; both domestic and foreign oil is available without long freight hauls; the extensive use of marine timbers require creosote; and the moist humid conditions require maximum protection from decay. Zinc chloride is not of proven value under these conditions, although experimental data give reasonable expectations that it will be sufficiently permanent to justify its use where a minimum first cost is essential.

The necessity for economy in treatment leads to the conclusion that, with air seasoned timber of such a character as to permit it, an empty cell process may be used for track ties and above ground structural timber.

For piling and other marine timber in this region, our recommendation is the continuance of the almost universal practice of using full cell treatment with coal-tar creosote. While other oils have been used experimentally, there is no evidence at hand to definitely prove the efficiency of water-gas-tar oil, hardwood creosote, or any of the other heavy oils.

Region II.—Abundant Timber and Dry Climate. (Average precipitation under 20″.)

Although treatable timber is not as abundant in this region as in the pine belt, ample supplies of track ties and structural material are available. Since treatable timber is comparatively cheap, an economical preservative is desirable. For most of the region in question, zinc chloride when properly applied meets all requirements, and since it can be shipped in dry form, is more readily available than creosote. Where local conditions justify it, we would recommend zinc chloride as a satisfactory preservative. This

would apply particularly to track ties and other material with a limited mechanical life. When available creosote should be used in moist situations even in a dry climate.

In the above we have recommended on the basis of available statistics and on the assumption that zinc treated material, even under the best conditions, will not be as permanent as creosoted timber. On the other hand, there is the theoretical consideration that wood properly treated with zinc chloride when used in overhead structures, is practically permanent. We would recommend that evidence on this point be accumulated, either by service tests or careful study of existing structures.

For structural timber and other conditions where creosote is used, the climatic conditions in this region are favorable to an empty cell process..

Region III.—The Moist Central Hardwood and Northern Mixed Forests. Average precipitation over 40″.)

This is a region of fairly abundant and greatly diversified timber supplies, with a variable climate and wide temperature fluctuations. Conditions are fairly favorable for the production of treatable material, and the cost, while varying through comparatively wide limits, is intermediate between the cheap timber of the South, and the expensive timber in treeless regions. Transportation facilities are for the most part good, and large quantities of treatable material are available on the lines, or within a short haul of most of the large railroad systems.

The larger part of the treatable material is hardwood. the principal kinds being red oak, beech, birch, maple and gum. In the northern portion of this territory conifers are available, including tamarack, jack pine and hemlock. The supply at eastern coast points is augumented by pine from southern ports.

All of the woods above mentioned treat readily with the exception of tamarack and hemlock, which although treated extensively, are usually listed as refractory. Both creosote and zinc chloride are used. Domestic creosote is extensively produced in this region, while large supplies of foreign creosote are received at the tidewater plants, and distributed inland to some extent. The cost of creosote in this region is at the minimum as is that of zinc chloride, which is also manufactured in this immediate territory. The choice of preservatives, therefore, depends on service

requirements and on the policy of the consumer, as to whether low initial cost or maximum life of material is desired. The factor of moisture enters into the consideration of zinc chloride in this territory; and because of the heavy rainfall, creosote is almost exclusively used in the eastern section. The Committee feels that both preservatives fully deserve consideration, and that final decision should be passed on the local or individual requirements of the consumer.

Practically all of the standard treating processes are in use in this region. The Committee can safely recommend that the full cell creosote treatment be used for all marine work; that for structural material, both full and empty cell processes are suitable if carefully adapted to the requirements; and that for track ties practically the same applies as for structural material. In other words, we would not recommend an expensive full cell treatment where ties under heavy traffic are not protected by tie plates, nor on structures of any kind which are not permanent in character nor fully protected from mechanical abrasion.

It is believed that the empty cell process will give a life from decay fully equal to the mechanical life, on track ties used under heavy or medium traffic, and on elevated structural material.

Zinc chloride either alone or in mixture with creosote, can be definitely recommended only for material which for any reason has a limited life from mechanical causes; but here, as in the South, additional facts are necessary before definite conclusions can be drawn as to the efficiency of zinc treated material in moist situations.

Region IV.—The Moist Heavily Timbered Sections of the Pacific Coast. (Average precipitation over 40″.)

This is a region of abundant timber, much of which is resistant to treatment. Red fir is the species most extensively treated, but an effort should be made to use more Western yellow pine.

Creosote in appreciable quantity is not produced in this region. Since the supply comes mainly from Europe, the cost is high, and it is used mainly on marine timbers. Broad factors of production and distribution prevail, and track lies in localities of heavy rainfall are often used in locations of low precipitation. Zinc chloride has been used extensively for ties and apparently with reasonable suc-

cess. Its use for this purpose is probably advisable if for no other reason than the high cost of creosote.

For marine work and where permanence regardless of initial cost is essential, creosote is recommended.

Region V.—The Treeless Plains and Prairies. (Average precipitation ranging from 15" to 40".)

The high cost of timber in this region, owing to transportation costs, justifies a treatment which reduces renewals to a minimum. At the same time, much of the territory is remote from producing centers for preservatives.

In the Eastern prairie regions of moderate rainfall, an empty cell creosote treatment will no doubt show the lowest annual charge. In the Western arid or semi-arid country, zinc chloride treatment is advised since climatic conditions are favorable and the cost of creosote would be too high. Exception to the latter is found within the limits of a reasonable distributing radius for creosote from Gulf ports in Texas. Another factor is whether the treated material is shipped in, or the timber and preservatives are assembled separately at a treating plant within the treeless belt.

Recommendations for Committee Work in 1915.

Realizing fully the fragmentary and incomplete nature of this year's report, the Committee recommends the elaboration of the fundamentals already stated, and the compilation of new material as follows:

1. Independent work and co-operation with other committees in preparing detailed specifications of timber for treatment.

2. Investigation of the scources of supply and available quantity of treatable timber in relation to its assembling and distribution.

3. Study of regional conditions as influencing availability of timber, cost of preservatives, and methods of treatment.

4. Specifications for treatment in relation to kind of material and service requirements.

5. Investigations and recommendations for preparing timber for treatment.

6. Service tests of zinc chloride alone and in mixture

with creosote in the East and Southeast, and of minimum injections of creosote.

E. A. STERLING, *Chairman*,
CARL G. CRAWFORD,
HERMANN VON SCHRENK.
WM. A. FISHER,
LOWRY SMITH,
A. C. BECKER,
Committee.

MR. E. A. STERLING: As a final word, let me say again that this report brings up a great many points which are open for discussion, and a great many questions on which there can be disagreements. The suggestion has been that the most effective use could be made of these ideas by submitting them through the proper channels to next year's Committee for careful consideration in Committee meetings. We could split hairs on a great many details here and probably never get anywhere, but I can assure you that as far as the present Committee is concerned they were only too glad to consider points brought up, and tried to round this report up in a finished form.

THE PRESIDENT: This is one of the most important committees that we have, and the nature of this work is, of course, preliminary, because it is really the first year of this Committee, and it has attempted to bring forth historical matter that will be of value to the future consideration of the Committee. We have only a very few minutes to discuss this work as we have to give up this room, having promised the room right now, but we will take 10 minutes more to discuss the work of this Committee. Let us make our remarks as rapidly as possible. I feel anyway that we can well afford to accept the summary of the fundamental principles as laid down in this recommendation for publication in our Manual.

MR. J. B. CARD: Mr. President, I would like to say a word. I believe that the time has arrived when this Association should go on record as to which of the present methods of treatment is the most efficient and economical for certain conditions. Before we can do this, however, it becomes necessary for us to obtain sufficient information as to the life of ties treated in the different ways.

Zinc chloride and the Wellhouse process have been used for years. The Lowry and the Rueping processes are 10 years old. Mr. Chanute introduced the Rutger process 10 years ago, and the Card process is 8 years old this summer. There have been hundreds of thousands of ties treated by each one of them, and I know positively that this Association can obtain plenty of evidence as to what we can expect

from each process if they want to go out after it. I think this Committee should be instructed to get all information possible and present it to the Association.

THE PRESIDENT: Have you any other remarks on this Committee report?

MR. L. E. HESS: Mr. President, do I understand that the report of the Committee as it stands now is voted upon for adoption and will go in its entirety into the minutes of the meeting?

THE PRESIDENT: The Committee's desire in this matter, as I understand, is that we publish the report, the text as we find it, as information and take action on the summary of fundamental principles for publication in the Manual. In other words, paragraph D is the portion that the Committee would like to have considered for publication in the Manual. The rest of it is for information of a historical nature, eliminating the seventh paragraph in regard to the minimum duration of treatment.

MR. L. E. HESS: I would like to study the summary then before I comment on it.

MR. S. R. CHURCH: Mr. President if it is in order to have this in the form of a motion, I move you that we accept for printing in the Manual the summary of fundamental principles under paragraph D, with the exception of the paragraph which the Committee withdrew.

MR. L. E. HESS: Mr. President, before that motion is accepted I would like to suggest that you give everybody a chance to read the summary. I do not think we are all familiar with the contents of that particular summary. Before you act on that motion I would like to consider it. I myself would like to read it. I could not vote intelligently without some knowledge of it.

THE PRESIDENT: Will Mr. Angier read the summary again?

Secretary Angier then re-read the Summary of Fundamental Principles which appears in the report of Committee No. 2.

MR. J. H. WATERMAN: Mr. President, I would suggest that pounds be used as the unit for cross ties, as well as for the other material, instead of gallons, and I will tell you why. I had the privilege of going down to Mr. Angier's plant some time ago, the B. & O. plant, and he has ties that have 2.5 cubic feet per tie, and some that have 4.5 Now, if you let a contract on the basis of so much per tie, your small tie gets enough, but how about the big ties? He has lots of ties that will measure 14 or 16 inches across. I think Mr. Angier will bear me out in that statement. I think it is a mistake to use the unit of gallons per tie where ties vary. It is all right where they are all sawed and all the same size.

MR. E. A. STERLING: That is what it says.

MR. J. H. WATERMAN: That will be misconstrued when it out.

DR. H. VON SCHRENK: Does Mr. Angier treat 2.5 cubic feet ties mixed up with 3.5 cubic feet?

MR. J. H. WATERMAN: A switch tie, did you say?

DR. H. VON SCHRENK: You said he had all kinds and sizes?

MR. J. H. WATERMAN: Yes, sir, it is good practice.

DR. H. VON SCHRENK: Does he mix them all together?

MR. J. H. WATERMAN: He did.

MR. F. J. ANGIER: We grade our ties as No. 1 and No. 2. We do not treat No. 1 and No. 2 ties together in the same charge. It is a fact, however, that we get some very large No. 1 ties, and that we do not separate the very large from the standard size No. 1. I really think this should be done to get the best results.

MR. J. H. WATERMAN: Now, Mr. Crawford treats ties commercially, and I will trust to his good judgment that he cannot afford to sort his ties, those with 2.5 or 2.8 cubic feet, and then take the larger ones and treat them in a cylinder by themselves, providing they are the same kind of wood. I agree with you, gentlemen, in classifying "A," "B" and "C." That is all right, but it is not practicable to separate ties of different dimensions and pole ties; it is not practicable to separate them and treat them, and this will be misinterpreted. Now, if the fellow wants to make a contract by gallons, he can do it, but I think we should stand firm on the unit per cubic foot basis, rather we should use the cubic foot and not the pound.

MR. E. A. STERLING: Mr. Waterman, this treating business is not an exact science anyway. Using any basis you please we all realize how difficult it is to arrive at a unit which will be satisfactory with all kinds of material. It has got to be averaged up. It is six one way and half a dozen the other when you average up the whole proposition.

MR. J. H. WATERMAN: I do not think so.

MR. E. A. STERLING: You are guessing at your average cubic contents when you state the number of pounds per cubic foot.

MR. J. H. WATERMAN: Well, you are sure when you are putting it in so many gallons per tie. I think you will come nearer to getting the unit. I will agree with you that yon do not get the exact cubic feet, but you will come nearer by using the cubic feet in the tie.

THE PRESIDENT: It seems to me that this is a subject of contract. It is a matter for individual decision. It might be desirable for one person to specify cubic feet and another person to specify pounds. It seems to me the very fact that ties on one railroad are

8.5 feet long and on another road 8 feet, and one railroad uses 7x9 and another 6x8, that this must necessarily be a matter of contract in this particular point that we are discussing. I would like to ask if we might have a second to Mr. Church's motion to accept the Summary of Fundamental Principles as published in "D," with the exception of paragraph 7.

MR. C. W. TIFFANY: I will second the motion.

MR. F. D. MATTOS: In regard to the temperature used in the boiling process of 220° F., does that not apply to sawed timber or does that refer to piling? You cannot work 220° F. on sawed Douglas fir without injuring the timber, at least that has been our experience.

THE PRESIDENT: That, of course, is the maximum, and in addition to this, Mr. Mattos, would it not be largely a question of the condition? Could you not apply a very much higher temperature to a thoroughly soaked or very green Douglas fir than you could to a dry Douglas fir? Is it not a matter of fact that we are applying in practice every day on the West Coast plants a temperature quite a little higher on green material than 220° as mentioned?

MR. F. D. MATTOS: Well, we do use 225° F. as a maximum on piling.

THE PRESIDENT: That is what this is intended to mean, the maximum.

MR. F. D. MATTOS: They ought to state it is the maximum.

THE PRESIDENT: Would the Committee consider the insertion of "maximum" in this one paragraph of 220° F.?

MR. E. A. STERLING: Yes.

THE PRESIDENT: The Committee will accept that.

MR. J. H. WATERMAN: Mr. Crawford started to speak. I would like to know what objection the Committee have to what I suggested.

THE PRESIDENT: I am sorry to have to close the discussion, but we are 15 minutes over the time we were to give up this room, and we will have to vote on this subject or continue the discussion tomorrow morning. Can we all be present tomorrow morning at 9 o'clock in order to get through with this program?

MR. C. M. TAYLOR: Is there a motion still on the floor?

THE PRESIDENT: There is a motion on the floor.

MR. GEO. M. DAVIDSON: I move we adjourn until 9 o'clock tomorrow morning.

THE PRESIDENT: Will Mr. Church consider the withholding of his motion and permit this motion to adjourn to be made?

MR. S. R. CHURCH: If the Committee so desire, yes.

THE PRESIDENT: It has been moved and seconded that we adjourn until 9 o'clock tomorrow morning. Please let us be present at that time.

Upon the motion being put by the President it prevailed, and an adjournment was taken until 9.00 A. M., January 21.

ELEVENTH ANNUAL BANQUET.

THE TOASTMASTER—G. M. DAVIDSON: Gentlemen, when your Entertainment Committee was arranging for this banquet we had in mind the old saying, "All work and no play makes Jack a dull boy." Therefore, we have arranged for some professional talent to furnish the relaxing portion of our entertainment this evening. We also thought we ought to have an education portion, therefore, we persuaded one of our progressive members to give us a little talk. He asked us what he should talk about, and we replied: "Give us one of those Mother Hubbard talks, one of the kind that covers everything and touches nothing." (Laughter.) Now, the gentleman who is about to talk to you has a postoffice address on the banks of one of our large rivers. He is very seldom there, but is perfectly at home almost any place in the world. He reminds me of the story of another gentleman who was born and raised on the banks of the Hudson River, a short distance above New York City. After having made his fortune he went to England to live, and finally died there. Now, in England they are very particular to carry out all the requests of a man's will, and when this man died they opened his will and found one of the requests was that he should be buried in Yonkers. They could not bury the man, because nobody in England knew what "Yonkers" were. (Laughter.)

Gentlemen, I have the honor and the pleasure of presenting, not introducing, one of our members, whose thoughts I am sure will be as welcome to you as sunbeams on a winter's day, Dr. von Schrenk. (Applause.)

DR. H. VON SCHRENK: Mr. Toastmaster and gentlemen: In rising to my feet I feel some embarrassment after this flood of witticism which we have listened to. This getting on your feet after eating a whole chicken has its embarrassments likewise. I meant to have told you a story in talking to you this evening, but since Mr. Davidson's story I have changed my mind, at least I have changed the story. (Laughter.)

I find myself in a somewhat embarrassing position after the introductory remarks. The embarrassment is, however, tempered with the feeling of appreciation for the invitation extended to talk to you.

I am reminded very vividly of a similar meeting, about 10 years ago, at which I think there were exactly 15 or 16 wood-picklers present, or as one of the distinguished gentlemen said: "There were 15 wood-picklers and one gentleman." I am sure I voice the feeling of this audience tonight in looking over them in saying to our President, Mr. Rex, that we feel very grateful to him for bringing about a gathering of this character, because I am sure we all put honor where honor is due. He has worked like a Turk all the year to do something for the wood-preserving industry, which is badly needed, mainly, a more self-assertive spirit, a higher appreciation of the fact that it stood for something, and I think the gathering tonight is perhaps as good an indication of that fact as anything could be.

Now, following Mr. Davidson's suggestion, I am going to try to make a brief talk. I asked him when he wrote to me what he wanted me to talk about and while he did not tell me that Mother Hubbard story he asked if I would be willing to repeat in a few words some remarks which I have had occasion to make here some weeks ago before the Western Society of Engineers in Chicago about some problems in which the wood-preserving industry to my mind is very deeply interested.

One of the chief reasons why the wood-preserving industry is coming to be something worth paying attention to is because it is beginning to stand for something. It deals with one of the products of the soil in which every individual, man, woman and child, is interested or ought to be interested. Unfortunately, however, that does not appear to be always the case. In other words, we are confronted in the United States today with a rather curious economic condition which some of us have felt particularly during these last 6 or 8 months and which we are going to continue to feel unless some very vigorous popular movement is started by those of us who are immediately interested in this work. The few things which I want to say deal largely with the problem of what the wood-preserving industry can do at this day to foster the proper use of preserved wood. That may seem like a truism, but there is a great deal more behind that than you would think, and with your permission I want to state a few of these factors as some of us see them.

Wood has been the oldest structural material that has been used by man for many years, and we have had abundant evidence of that in this country. In fact, we have had the largest use per capita of any nation in the world. There is at the present time, however, a movement on foot (it is not an organized movement by any means, but it is a tendency perhaps, I ought to say) for a very rapid restriction of the amount of wood used by the people of this country, and, of course, the wood-preserving industry is going to feel that together with other phases of the lumber industry. The lumbermen of this country have

become considerably exercised as a result of the reduced amount of wood sold, and they are trying to find out exactly what has hit them. They know that it is something, but they cannot quite make out what it is. These tendencies may be briefly classified into two or three groups. In the first place, the people of the country demand wood for various purposes. They hitherto were able to obtain it at low cost without much difficulty, and generally of a satisfactory character. With the increase in population, with the greater distance to which the material had to be hauled, and for other reasons too numerous to mention here, it has come about that a great deal of wood which is furnished for various purposes does not seem to fit the requirements which are demanded of it. In other words, a good deal of wood now being used is being used in a way which it is not fitted for, and as a result of which a prejudice, or a feeling, has arisen among the people using it that they will throw it out and use something else. We see that every day. Claims are made that the wood rots fast, it burns. that it is not strong enough and a thousand and one other objections are raised to it.

The producing industries, including in that ourselves, have done very little to educate the people of this country as to the significance of those appearances.

It has been left entirely to the individual who buys timber how he shall use it, whether it is fit or not according to his judgment, and he frequently maltreats it; he generally uses it in a way which leads to the disintegration of the timber after a short period of time, and that tendency is very rapidly increasing. It is being rapidly increased and helped along by a very highly intelligent body of people who had other things to sell and who go to the prospective user of any kind of material and hand him something on a silver platter; who go to every possible device to make the sale of their product attractive and who use the failure of the wood to serve a specific purpose as their chief talk, and naturally so. The concrete salesman likes nothing better than to come to a home where the sidewalk planks in front of the house or the stairway or the porch show a lot of rotten timbers, because that immediately gives a starting point as to why the particular house owner should use concrete and why that sort of thing would not happen.

The wood-preserving industry is interested in that phase of the situation very deeply, because it forms the intermediate station between raw material and the other classes of material. You can see readily enough that if the house owner puts up a wooden porch and it decays in a very short time and a concrete salesman comes along, it is going to be an easy matter to persuade that person that it is the inherent quality of the wood that caused the difficulty. The house owner does not stop

at an intermediate stage. He immediately goes to concrete, and blames wood as a whole.

This agitation, which is being conducted on the part of representatives of materials other than timber, is, as I say, a very vigorous one. They do it by advertising; they do it by personal solicitation, by the holding of exhibits—take, for instance, here in this City of Chicago. There is a great exhibit in one of the buildings here of building materials in which there is not a single stick of wood represented today in any way, shape or manner. They do it by the issuance of pamphlets and publications, some of which have even gone so far that they ask you to pay for them. I could have brought a small trunk full of stuff, but here for example is a pamphlet issued by the Atlas Portland Cement Company, which is used as a text book in a great many of our colleges, entitled "Concrete and Railroad Construction," published by the Atlas Portland Cement Company. The significant thing I would like to call attention to is on the front page, where it says, "Price, $1.00." Now, gentlemen, no doubt that information is of high order, but the Atlas Portland Cement Company not only wants you to buy their stuff but pay them a dollar for the information which they give you about it.

Here is another one issued by the Universal Company, called "Small Farm Buildings of Concrete," which are being sent out to anyone who applies for them, in which you will find photographs, and the startling part of the whole pamphlet is the fact that in it there are instances giving the failures of concrete material from cracking and showing how not to use concrete and what will happen to you if you do not use it right. They not only do that, but they issue small circulars, written by one of the chief concrete experts, in which they show if you do not use concrete right it is liable to crack and fail, and they tell you why.

Illustrations of that type I might multiply by the hundred. They are progressive. They are active. Here is a good one taken from the frontispiece in the last number of the "Engineering News" immediately after the Edison fire. You will see the advantage which the metal window sash people took of that by calling attention immediately to their particular product, a perfectly legitimate and straightforward piece of advertising.

Now, these movements are being assisted not only by legitimate business methods but by all kinds of propaganda, some of them absolutely altruistic and some of them not so. One of the movements which is going on at the present time is the endeavor on the part of the people in this country to reduce the enormous fire loss in our cities and communities, amounting to something like $300,000,000 a year.

We have two very strong national organizations at the present time that are active in calling to the attention of the citizens of the

United States these enormous losses. One of the chief points of attack naturally, and the easiest point of attack of those organizations, is to reduce the amount of combustible material of which buildings are built. I have recently had dealings with the gentlemen of both these Associations, and I am thoroughly convinced that they are absolutely altruistic and straightforward in their motives in handling these large questions, but, unfortunately, a great many of the dicta which are issued by these organizations are misinterpreted in a way which is distinctly antagonistic to the use of wood as a structural material, and that is taken advantage of by the various people who substitute their material for the wood structure. That is not the worst of it. There have sprung up in various sections of the United States organizations whose motives are not so altruistic. I have just received this afternoon a telegram of invitation from the City of Cleveland to address the members of the Council in a week or so on the subject of an organization which was started in Cleveland a few months ago called S. A. F. E., the society advocating fire elimination, and I was looking over a list of their members this afternoon, some forty odd people, all of whom are dealers in brick and cement, slate roof and asbestos shingles, and their slogan to the people of Cleveland is illustrated very well by these stickers which they are sending out by the thousands. "Let the trees grow. Build with non-burnable material and be safe."

Now, gentlemen, I can only give you one or two instances of this character, but it is so obvious on the face of it what that movement amounts to as far as the citizens of Cleveland are concerned that there cannot be any discussion about it. You may not be able to see this diagram, but it is a diagram which is published by the United States Geological Survey on the cement produced in the United States, beginning with 1890, and note the upward tendency of that curve which runs over a period from 1890 to 1913 from practically nothing to a production of 92,000,000 barrels in 1913. Compare that with the way in which the utilization of lumber has gone.

Now, you are going to ask me what does that all signify. I want to show you one other thing. A few weeks ago there appeared in the "Saturday Evening Post," of Philadelphia, some apparently innocent articles. The central idea of the articles was that the man was supposed to own his own house, and then the subject "How can I protect my wife and children so that my house won't burn," and the tenor of the whole article is "Don't under any circumstances use a piece of wood as large as a match stick." That tendency is being formulated into ordinances which are extreme, such as the one recently formulated in the City of New York, which aimed to prohibit the use of wood in the construction or for use in any building over a hundred feet high, including furniture and everything, and as I told the gentlemen who were considering this subject a couple of months ago the only thing

they permitted in the way of wood, or the only thing they did not prohibit in the way of wood, was the wood in the lead pencils in the office building. We discovered, at least the commission discovered, of its own free will, that the motive behind that ordinance did not consist of steel men or fire protection associations, as many would have us believe, but it was fostered by a number of real estate men in New York City, who will gamble on the increased values the then existing buildings had when that ordinance passed. The average wood-preserver does not appreciate the far-reaching character of a great many of these particular organizations or the insiduousness and quiet nature in which they work. We frequently meet it on the railroads. We sometimes meet it around in the cities, but we do not appreciate the sum total of its effect.

Now, as I say, you may ask me what we have to do with that. Some years ago—I may have told some of you this story—I met an old German farmer down in Texas who had just come to this country to spend his declining days. He found out I was interested in cross ties and things of that nature and as we were talking he said: "Why, you know down here in Texas we have an awful state of affairs. You know, in my father's home we had chairs and tables and furniture that belonged to my great grandfather, and if we boys smashed anything, any of that furniture, why it was sent to the cabinet manufacturer and carefully repaired. Now, down here they don't do that. When the boys break something they throw it out on the wood pile and buy a new one. This is a scandalous country."

Now, gentlemen, that old man struck the keynote of our modern American attitude toward materials. We are absolutely wasteful. We have no respect for material. It is positively cheaper to buy new chairs than to mend the old ones, but it signifies our lack of fundamental respect for the material. You cannot interest a man in the conservation of a forest tree, even as our friends in Cleveland would have us believe with these circulars; you cannot interest them in the forest tree if they have no respect for the chair and the table and so on that they use in their homes. As long as the people of this country are going to handle wood as a negligible factor just so long will we have difficulty in impressing them with the fact that it is desirable to use it economically and, above all, to use it in the preserved condition and make it last. Most of the business we are engaged in deals with large quantities of stuff, railroad ties, piling, and things of that sort. We have not yet touched the average man. A few weeks ago I met a friend of mine, the president of a large company in New York City, and he told me that he had purchased a creosoted garage in England and had it shipped to this country and put up. Well, I nearly collapsed when I heard that.

But here is the catalogue. These English gentlemen creosote wood for farm and city buildings and they have yards where you can get this creosoted wood by the stick and they show in this catalogue complete barns and buildings of that sort built with creosoted material. What would you suppose would happen to me if I went to a plant to get a half dozen 2 by 4's of treated wood? You would laugh at me. You would begin to talk volumes and talk the way the steel people would if you wanted a spike. Now, here is the situation. There is a decreased demand for lumber taking place, and the plea I want to make to you is to get behind a more or less organized propaganda which is just starting among the lumbermen of this country. We are going to hold, as I believe Mr. Sterling told you this morning, a congress here in Chicago on the 24th of February of the various interests of the lumber industry from the Atlantic to the Pacific for the purpose of devising ways and means of telling the people of the United States why there is still some wood left and why it is good for them to use and how to do it. That can be done. Personally, I was a great skeptic on the possibilities of advertising such a common thing as wood, and I want to tell you the experience of one organization. Last Thursday I spent some hours in New Orleans with some of the cypress men, and some of you may have read of the "wood eternal" in recent magazine articles and in various places. The cypress industry 5 years ago cut 800,000,000 feet of lumber. Last year they cut a little over a billion feet; in other words, an increase of 200,000,000 feet in five years. Five years ago, in 1909, of that 800,000,000 they sold 300,000,000 feet to the factory trade. Last year they sold practically no factory trade. In other words, there was 300,000,000 feet of trade which they lost, due to lack of consumption, and increased their output 200,000,000 feet, making a total of 500,000,000 feet. In other words, 50 per cent. of the output of the entire cypress industry went somewhere where it had never gone before. Where did it go? It simply went to the people who demanded it as a result of the fact that the cypress industry of this country spent a few paltry thousand dollars advertising their products to the people of the United States. One of the selling organizations in New Orleans last year put 716 retail yards on its books who had never handled a square foot of cypress before. Why? Simply because the people asked for it.

Last week I was coming from New York to Chicago, and I met a rather distinguished-looking gentleman in the smoking car. He looked out of the window, and as the train went on he said: "Did you see that bungalow?" I said; "Yes." He continued: "You know there is a funny thing about that. I don't own a farm or a house or anything of that sort. I live in Chicago, but some day I am going to put up a bungalow. Do you know what I am going to build it of? I am going to build it out of cypress, the wood eternal." I said, "that is

kind of funny; why would you do that?" He said, "I don't know, but every time I see a bungalow I see the wood eternal."

Now, gentlemen, that is bringing the material home in a way that the public appreciate, and the reason the cypress people were able to do that was because they had a good kind of stuff, and they told how to use it and why and got the people interested, and their message to the wood-preserving industry is "Go and do likewise." Why should we not? Wood-preservation means essentially, if I understand it correctly, in its broadest sense, making something which is not particularly fit for a very high-grade purpose eminently fit for such purpose. We heard one of our members this afternoon tell us something about the difficulties in getting proper timber for construction purposes in factory buildings, a fact which is absolutely true and which is increasing all over the country. The material is not fit for use in certain kinds of construction work. Our best timbers or any of our timbers will decay and why should we not get up and admit that it does. What do the steel men do when they put up a steel bridge? They tell you that you must not only do what they tell you to do, but the minute a steel beam is in place there is a fellow out there with a paint brush so it will not rust. Why should we deny the fact that the best of wood is liable to decay?

The wood-preserving industry is, therefore, only one phase of a natural economic development which is bound to come, namely, teaching the people of this country that they have a very high-grade class of structural material which is still very abundant and which if they treat it properly is the most desirable article to buy. The lumbermen of this country are thoroughly aroused to that situation. They are going to come to you and me and all of us, and are going to ask our assistance and help in making a superior product. They are going to come to you and they are going to the retail distributers and say: "Here, Mr. Jones, we want you to see to it that your company keeps in your yard a certain amount of creosoted and zinc-treated timber for sale in small lots, whatever it may be, which you can tell your customers it is to be used in such a way and is of such a character; that it is economical and have your company ready to demonstrate its use." These diagrams are unfortunately too small for you to see them, but I had them drawn up by an engineer recently, giving a comparison of the costs of yellow pine lumber, concrete and steel for certain types of load. Here is one I think for floor load, 6,500 pounds with a span of 12 feet. Here is a yellow pine stringer, reinforced concrete beam and here is a steel beam. The actual cost of the raw material at present market prices is $0.96 for the yellow pine stringer, $2.65 for the reinforced concrete beam, and $2.65 for the steel I-beam. Let us take a larger floor load with a load of 17,000 pounds and 15-foot span. You get a price of $3.84 for pine, $5.67 for concrete, and $6.75 for the steel

I-beam. Now, gentlemen, you know that is something the average man does not know. Certainly the concrete salesman is not going to tell anybody about it and why should we not do so? Those figures indicate, particularly in the smaller sizes, that the common argument that many of us here make that the lumber cannot stand the additional cost of the preservative absolutely is not so, because the cost ratio is 1 to 2.8 and the wood makes a very much more desirable material for various purposes, not for all, please, but for many purposes, and the place where we are going to recommend wood is going to depend upon its adaptation.

I might go on indefinitely citing instances of this kind. The article which appeared in the "New York Herald" on the front page about the Edison fire did not deal with the Edison fire, but dealt with the poor wood. I think most of you can see that. I am showing you this not to accuse the other man, but simply to give you an idea of the agitation which is going on, which in many cases is not intended to be harmful, but in a great many other cases it is.

How are we going to work this thing out is the question some of you may ask me. The chief point I would like to leave with you in connection with this question is that we get together in these matters. We meet here in these conventions and we talk about the use of creosote, whether we should recommend 25 per cent. naphthalene in creosote, or whether we should do this, that, or the other thing, and we go at each other like lions. Now, gentlemen, it is a mighty poor kind of aggregation if we do not have differences of opinion when we get together in a room like this, but when we go out let me tell you let us forget about that thing. When we leave this meeting room let this industry represent a solid front to the people that are outside of it. Let us present a solid front of efficiency. Let us talk continuously about the desirability of using properly creosoted, properly zinc treated, properly other kind of process treated wood, whatever the case may be. Let us forget about the small, insignificant factor of each member and let us talk about the advice that the consumer should have, how to handle his stuff in order to make the best of it.

We differ, as I say, upon methods; we differ on details. After all, when you come to think of it, they are very small, and when we leave these meetings the one inspiring thing that we have is this organization; we have this crowd of people who are spending a lot of time, efforts and enthusiasm in promoting the things that we all stand for. Let us forget those differences, and let us stick together in telling not only the people but the lumbermen with whom we have to work. Let us tell them about these talking points, about the future of the industry, because you have much to talk about and so many good things to say about the particular product that you handle, and it will not be long before we will make an impression upon the average consumer of which

many of you do not dream at the present time. It is certainly well worthy of the best of us and something which we can all get together on, because if we do not do it I would hate to say what the outcome will be, because there are certain tendencies and motives and power and capital which are behind these various other propositions and that is something most of you underestimate. Go home and keep a watch on your magazines and your various organizations and see what it signifies. The first practical co-operative proposition is going to be at this forthcoming congress at Chicago. I would like to have you all go home and boost with your local men, all of you come here if you can and listen to the reports which the committees are going to present, get together with the particular local secretaries of the lumber associations in your particular communities, co-operate with them to the extent that through the broader organization representing all the lumbermen in the country there may be brought to bear an unified effort, and I am very sure that before very long many of those apparent difficulties will be done away with which appear rather large and loom big in the meetings at the present time. I thank you. (Applause.)

THE TOASTMASTER: Gentlemen, I think you will agree with me we did not make any mistake in selecting the gentleman to give us the educational portion of our entertainment. I hope you will carry home with you a great many of his thoughts, and I trust that you will help boom the wood industry.

Some very clever readings were then given, and some unique performances by a magician concluded the entertainment of the evening.

THURSDAY MORNING SESSION.

January 21.

The convention came to order at 9.30 A. M.

THE PRESIDENT: Mr. Angier has several communications which I will ask him to read.

Communications were then read by Secretary Angier from R. J. Calder, E. H. Bowser, John B. Lindsey, E. E. Draper and L. T. Ericson.

Communications.

[Telegram.]

Galveston, Texas, Jan. 19, 1915.

Geo. E. Rex,
Pres't. American Wood Preservers' Association,
Congress Hotel, Chicago, Ill.

Regret exceedingly that at least one of our company is not able to attend convention. Wish you most successful meeting. Will do better next year.

R. J. CALDER.

Memphis, Tenn., Jan. 18, 1915.

Mr. Geo. E. Rex,

President Am. Wood Preservers' Association, Congress Hotel, Chicago, Ill.

Dear Sir—I was getting ready to go to Chicago tonight to attend Wood Preservers' meeting, but was compelled to change my plans and will go to New Orleans, as we expect a vessel of English oil tomorrow or next day which we are trying to make a deal for, and, of course, I cannot miss a chance to get English oil. I will not be able to be in Chicago during the meeting.

E. H. BOWSER,
Supt. Timber Department,
Illinois Central Railroad Co.

Gautier, Miss., Jan. 18, 1915.

Mr. Geo. E. Rex,

Pres. American Wood Preservers' Association, Chicago, Ill.

MY DEAR MR. REX—I regret very much that it will not be possible for me to attend the 11th Annual Convention of the American Wood Preservers' Association.

Hoping the Convention will be a success in every way, I am, with kind regards,

JOHN B. LINDSEY,
Supt. Timber Treating Plants,
West Paseagoula Creosoting Works.

[Telegram.]

New York, N. Y., Jan. 19, 1915.

Geo. E. Rex,

President American Wood Preservers' Association, Congress Hotel, Chicago.

We greatly regret our inability to be with you. Hope your convention will be largest and best ever.

E. E. DRAPER,
L. T. ERICSON, Engineer American Creosoting Co.

THE PRESIDENT: While we are waiting for the rest of the members of the Committee I am going to ask Mr. Church to show us something about a distilling apparatus for testing creosote oil.

MR. S. R. CHURCH: Gentlemen, I have asked the President and the Chairman of the Program Committee to let me say a word about the distilling apparatus used in testing creosote oil. While our

creosote supply from Europe may or may not be cut off by reason of the war, it is certain that the war has seriously interfered with the supply of apparatus for distilling oil in accordance with the standard requirements of the American Railway Engineering Association. Heretofore, the only source of supply of 8-ounce retorts that were at all uniform in capacity has been the glass works at Jena, Austria. Even in normal times it has been rather difficult to obtain retorts of uniform capacity, but by taking the matter up direct with the manufacturers at Jena we have succeeded of late in obtaining retorts of reasonably uniform dimensions. Today the supply of these Jena retorts is extremely limited, and it is a question how soon any more can be obtained. (Standard type of distilling flask as specified by the National Electric Light Assn., Forest Service, U. S. Dept. of Agriculture, and Roads Materials Committee, American Society for Testing Materials, were also shown as a matter of general interest.) Some time ago I took up with American chemical supply houses the question of manufacture of retorts in this country, according to definite specifications as to dimensions and capacity, but they turned it down. It seems that the glass-blowers here are not expert enough.

A few weeks ago I called on Mr. Cary-Curr of the E. H. Sargent Company, and together we went over the problem very carefully, and finally he suggested that we take a distilling flask, cut off the neck to within about an inch of the bulb, and place the offtake tube as near as possible to the bulb, thus making a vessel which practically complies with the specification for the 8-ounce retort. It is, in fact, a retort having a round bulb instead of a pear-shaped bulb. The distance from the end of the thermometer to the end of the offtake tube can be exactly the same as specified in the standard retort distillation, the same asbestos cover can be used, and as a matter of experience we find that results of the tests are practically the same with this as with the retort. We have already tried out one or two of these flasks in our laboratory, and I merely suggest at this time, if any of you are utterly unable to get retorts, you might, as an alternative, use this distilling flask. The Sargent Company is ready to make them, and I have no doubt that any of the other supply houses would make them also.

THE PRESIDENT: Might I ask what particular term would be applied to that?

MR. S. R. CHURCH: Well, I do not know, Mr. Rex, but Mr. Cary-Curr of the E. H. Sargent Company will understand if anyone writes to him for a special distilling flask. He will know just exactly what is meant. Now, I would be glad to go into the thing more in detail if we had more time. I just wanted to bring it up and everybody that is specially interested can ask me more about it afterwards.

THE PRESIDENT: We thank you, Mr. Church. The matter for consideration on our program this morning is the continuation of the consideration and report of Committee No. 2. The gist of the report in the situation as we left it last night was that the Committee had recommended for adoption for the Manual the paragraphs under "Summary of Fundamental Principles" appearing in their report with the elimination of paragraph 7 beginning "the mean duration of treatment," and so forth. Mr. Church made a motion to accept this summary for printing in the Manual, and the motion was seconded. It is now in order that we have any comments on this motion.

MR. J. B. CARD: Mr. President, I would like to ask one question about drying the wood. This says to air-season the wood to not more than 20 per cent. of its dry weight. I would like to ask if it is the purpose in seasoning oak ties to get them to as low a weight as that? That means about 45 to 46 pounds a cubic foot, as I understand it, and that is pretty light.

MR. J. H. WATERMAN: I would like to ask a question for information. If we pass this motion does it mean that we print the report of the Committee as information and that we recommend the paragraphs referred to; is that it?

THE PRESIDENT: Yes. Let us know exactly what we are voting on. This is the report of Committee No. 2, and if this motion is carried we accept the entire publication as information and recommend the "Summary of Fundamental Principles" as appearing under "D" for the Manual, and in answer to Mr. Card's question I expect the Committee would rather answer this, but I will just call his attention to the last part of that paragraph, in which it says: "Or to a constant weight basis."

MR. J. B. CARD: Yes, I noticed that part of it. It mentions the seasoning of the wood to not more than 20 per cent. of the dry weight, and it struck me that this was a very light weight.

MR. E. A. STERLING: We had considerable correspondence and discussion about that, Mr. Card, and I think all that is meant here is that this constant weight basis would be the lowest practical weight possible under the particular conditions. Does that cover the point?

MR. J. B. CARD: I wanted to get straight on it, because in air-seasoning oak ties we have not been able to get much lower than 50 pounds to the cubic foot, and as I understand this moisture content that would mean about 30 to 35 per cent. moisture. I may be wrong, but that is my impression.

MR. E. A. STERLING: Under certain conditions it is thought it might be desirable to get down to a definite minimum percentage.

MR. J. B. CARD: If you say "constant weight basis," why that would be all right. I do not think it is possible to get 20 per cent. moisture.

MR. E. A. STERLING: The constant weight basis in a particular yard with one particular bunch of ties would mean getting them down to the point where they would not lose any more weight.

MR. J. B. CARD: That is all right.

MR. E. A. STERLING: That is what it was intended to be. It is not in a technical or scientific sense.

THE PRESIDENT: Any other comments on this motion? If not, all in favor of accepting this motion as made by Mr. Church will signify it by saying Aye; contrary, No. The motion is carried. Has the Committee any suggestions for the work for the next year that they would like to submit? If there are no further suggestions on that we will thank the Committee for the work they have done this year.

MR. E. B. FULKS: Before that Committee leaves I do not want to seem unnecessarily to delay this thing, but the vote was taken while I was looking the other way. This Committee has one sentence in here from which unintentionally an inference may be drawn which I think they do not desire and which I do not like to see go by. In the paragraph with regard to coal-tar creosote, in the last part of the middle paragraph, it says: "It naturally follows that the less the injection the better should be the quality of the creosote, from which it is evident that the heavy, high boiling creosotes represented by the German product is preferable for empty-cell treatment." The part I take exception to is that "represented by the German product." Of course, we all understand here that the Committee simply mentioned that for the reason they wanted a good, high boiling oil, but by an outsider the inference may be drawn that this is only represented by the German product, which is not true. An oil can be made in this country very easily as good as the German product and I would like to see that changed.

MR. E. A. STERLING: Would it be better to say "as represented by Grade 1 oil?"

MR. E. B. FULKS: I have nothing to offer except that I think a wrong inference might be drawn.

THE PRESIDENT: The Committee is willing to consider that change instead of "as represented by the German product" to make it read "as represented by Grade 1 oil." Does that meet with your approval?

MR. E. B. FULKS: It is perfectly satisfactory to me.

THE PRESIDENT: Are there any further questions you would like to ask the Committee before they are dismissed? If not, we will excuse the Committee.

(Vice-President Crawford then took the Chair.)

CHAIRMAN CRAWFORD: We are a little behind with our program and have not quite cleaned up that part which was to come yesterday, and we still have our program on wood block paving to come before us this forenoon. This will necessitate some rearranging of the program this morning which is regrettable but which is necessary in order to get through with it.

The next thing will be a paper by Mr. Angier on "Still Ties."

MR. J. H. WATERMAN: Mr. President, I know Mr. Angier pretty well, and I am sure that he will be glad to waive the time and pass this paper and print it in the Proceedings, and I make a motion to that effect. I wish I knew the other gentlemen as well as I do Mr. Angier. I wonder if there is not a number of these papers that we can include in this motion?

CHAIRMAN CRAWFORD: I will just say there are three papers yet to be read and discussed, one by Mr. Angier, the one by Mr. Christian on "Destruction of Timber by Marine Borers" and one by Mr. Cherrington on "Laboratory Analysis After Treatment Versus Actual Record During Treatment of Creosoted Wood Paving Blocks." Mr. Christian is not here, and I do not know whether Mr. Cherrington is present or not.

MR. J. H. WATERMAN: I will move that Mr. Angier's and Mr. Christian's paper be printed in the Proceedings, and that we dispense with the reading of them at this time.

MR. F. J. ANGIER: I second the motion.

CHAIRMAN CRAWFORD: You have heard the motion. Are there any remarks?

MR. S. R. CHURCH: Mr. President, I rise for a point of information. Does that exclude the discussion of those papers?

CHAIRMAN CRAWFORD: We will call for a discussion, if it is so desired.

MR. J. H. WATERMAN: If any man wants to comment on them we ought to let him do it.

CHAIRMAN CRAWFORD: A motion was made here to dispense with the reading of these papers. All in favor of passing over the reading of these papers will signify it by saying Aye; contrary, No. The motion is carried.

First we will take up Mr. Angier's paper and ask if there are any comments or discussions on it.

SILL TIES.

By F. J. Angier.

Seasoning conditions in tie storage yards vary considerably—one yard may be nicely drained and ballasted; another may harbor conditions which are conducive to the decay of timber. It is fair to assume that there can be found in all tie yards more or less decayed timber, and, generally speaking, this decayed timber will be in direct contact with the ground. To reduce this useless waste of good material resort may be had to placing the ties for seasoning on sills that will not decay. These sills may be of wood chemically preserved, or they may be of concrete.

For the purpose of this paper we will consider the tie storage yard of the B. & O. R. R. at Green Spring, W. Va. The present trackage provides for the storage of, approximately, 600,000 ties. This is calculated on a basis of cribbing ties in lots of 100, making four cribs to a pile and 1,500 piles. This will require 12,000 sill ties to season the maximum number of 600,000 ties. Every sill tie is in direct contact with the ground.

Approximately 75 per cent of all ties received for treatment at this plant are purchased as No. 1 ties and 25 per cent as No. 2 ties. The cost varies in different localities, but we can assume that the average price paid for No. 1 ties is 60c; and for No. 2 ties 40c.

We believe it conservative to say that 10 per cent of the untreated sill ties check or are damaged to such an extent that they can be used only as No. 2 ties; and 2 per cent of all sill ties are broken or decayed to render them practically worthless.

Using the above estimate as a basis, we may obtain the following:

Cost of Untreated Sills.

10% of No. 1 ties, or 900, are made No. 2 at a loss of 20c each	$ 180.00
2% of all sill ties are made worthless.	
180 No. 1 @ 60c each	108.00
60 No. 2 @ 40c each	24.00
Labor of turning over 12,000 sill ties and cleaning for treatment at ½c each	60.00
Restacking yard for locating sill ties	30.00
Disposing of worthless ties	6.00
Cost for six months	$ 408.00
Cost for one year	$ 816.00

Interest and taxes one year on 12,000 sill ties ($6,600.00 @ 7%)		462.00
Total cost for one year		$1278.00
Or, per sill per year		0.1065

Cost of Treated Sills.

No. 2 ties each	$0.40	
Cost of treating and laying	0.18	
	$0.58	
Interest and taxes (6% plus 1%)		$0.0406
Renewal cost (assuming 20 years life)		0.0290
Annual cost per sill		$0.0696
Total cost for one year		$835.20

Cost of Concrete Sills.

12,000 at an estimated cost of 80c each	$9,600.00	
Labor, installing	300.00	
Total cost 12,000 sills	$9,900.00	
Cost per sill	0.825	
Interest and taxes (6% plus 1%)		$ 0.05775
Renewal cost (25 years' life)		0.03300
Annual cost per sill		$ 0.09075
Annual cost (12,000 sills)		1,089.00

RECAPITULATION.

Cost per year.

Untreated sills	$1,278.00
Treated sills	835.20
Concrete sills	1,089.00

These estimates show an annual saving in using treated sills over untreated of $443.00, and over concrete of $252.00. The cost of concrete sills may vary one way or another but the estimate shown above is believed to be conservative.

An indirect saving should be credited to the treated and concrete sills of—

(a) No infection of sound ties from contact with decaying untreated sill ties.

(b) Less injury to valves and pumps by cinders and other foreign matter carried into the retorts on ties that have been in contact with the ground.

(c) Untreated sill ties that have been in contact with the ground are not as well seasoned as other ties in the same pile; therefore, when loaded in same charge they may be under-treated and their life shortened.

The cost of ties and their treatment will vary—some plants may use cull ties, which cost practically nothing. The B. & O. R. R. will not purchase cull ties at any price; and, therefore, sill ties must be made from the ties in stock, and these must be charged to stock account at the prices paid.

This paper has been submitted for criticism to a practical plant operator who maintains one of the best, up-to-date tie yards in the country. His comments were prefaced with the following "ifs":

If your sill tie rests on sand;
If your sill tie rests on clay;
If your sill tie rests on cinder;
If your yard is located in a humid region;
If your ties are green when piled; and
If you use only pine ties as sills, etc., your results will be different.

These statements are true, and the writer believes there will be conflicting views on the subject of "Sill Ties" and that his assumptions will be criticised, for the reason that the conditions which exist in one yard may be absent in others.

It was with the view of ascertaining the opinions of those who have made a study of this problem that this paper was prepared, and it is hoped that the discussion will throw more light on this feature of the timber-treating industry.

MR. W. L. BACON: As to the treated sill tie proposition, we have had that question up from time to time and given it consideration in connection with the conditions to the plant. I think whether or not the sill tie is necessary depends very much on the section of the country the plant is located in, and other conditions present. My experience has all been in the northern part of Michigan, where we have much cold weather and snow to contend with.

We have handled something like 7,000,000 ties through the yard, and I have as yet to find a sill tie decayed resulting from lying on the ground, and in some few cases such sill ties may have remained down and have had a second lot of ties piled on them. We do not purpose to allow this except as a tie here and there may not have been taken up when other ties were. Then, again, the use of a permanent sill tie would hamper our operation in other ways.

I would consider that in cases where all ties received in the yard come barked that a permanent sill tie would be a good thing, but

where all ties come in with the bark on and piled out to season with the bark on, which is the practice in our case. that to have such permanent sill ties, the picking up of so much bark after peeling the ties would be very much harder. Our main reason for not using the sill tie referred to in the paper is on account of contending with so much bark, and for the further reason that ties lying on the ground a full year take no harm on account of the long cold period and a short period of hot weather.

MR. F. J. ANGIER: How long do you season your ties, Mr. Bacon?

MR. W. L. BACON: All the way from 90 to 120 days, from April 1st. We usually begin peeling ties about July 1st; that is, as soon as we can do it. We usually begin treating our hardwood first. We have found by experience that we had to remove the bark, treat, and get them out of the way during that same year and not carry them over. We have to begin work on hardwood 90 days from April 1st.

CHAIRMAN CRAWFORD: I think most of us appreciate the difference between conditions found in the north, such as those which are present where Mr. Bacon operates and those which are present down on the Gulf Coast, the prevalence of rot being very much greater down south than it is up north, and as Mr. Bacon has stated they do not carry their ties very long in seasoning them, consequently the necessity of sill ties due to rot are not so great as in other sections of the country and where the seasoning period is much longer. Is there any further discussion?

MR. WM. A. FISHER: I would like to ask Mr. Bacon if he treats his sill ties at the same time he treats his ties that were above them in stacks or whether he takes up the sill ties and allows them to season a little further before he treats them. In our experience the sill ties are not ready to treat when we treat the rest of the stack.

MR. W. L. BACON: We make no exception, Mr. Chairman. The sill ties are treated at the same time the rest of the pile are treated.

MR. J. H. WATERMAN: There are often ties split badly, what we call rejected ties. There are always a few of those come into the yard where you handle 1,500,000 or 2,000,000 a year, and we lay those to one side, and treat them by themselves, and use them for sill ties. It is not economical to start out to treat the sill ties separately because that would necessitate picking them out of 1,500,000 ties. We treat a few at a time. It may take us one or two or three years to get all our sill ties treated, but by doing that we use the ties economically, ties that cannot be used for anything else, or ought not to be used for anything else.

MR. F. J. ANGIER: We do exactly as Mr. Waterman does, that is, treat the sill ties that cannot very well be used for anything

else, or in other words, ties that come into the yard grading less than No. 2 or have been made defective while in the yard. Such ties may have been inspected and paid for as No. 2's and in some cases as No. 1's, but when they are treated for sill ties they are either so badly split or otherwise defective that they cannot be used as No. 2 ties in the roadbed. They could be used in temporary tracks, and many are used for this purpose, but the few sill ties we require are taken from this class, and in this statement I have charged sill ties with what we had to pay for them.

MR. O. C. STEINMAYER: Mr. Angier, in his calculations to show the advantage of the treated sill ties over the untreated sills, has wrongfully included interest and tax charges on the untreated sills. These ties, according to his assumptions, are seasoning for treatment during the time they serve as sill ties, an allowance being made for loss during this seasoning period. Consequently, interest charges should not be made on them any more so than on any ties which might be stacked on these or any other sill ties for seasoning.

There are objections to untreated sill ties as well as the concrete sill. Mr. Angier has mentioned many of them, and I think his objections to the untreated sill tie are well taken. In addition to these it might be added the question of breakage. This in the case of the concrete sill tie would be a factor which would undoubtedly make them very expensive. Then, too, if untreated sill ties are used, they would be a source of infection for all ties that might be stacked on them the moment they become decayed. We cannot compute what the loss of ties will be from being stacked on such untreated ties.

DISCUSSION ON SILL TIES.

By Samuel T. Pollock.

In discussion of the paper on Plant Operation a possible method was suggested of getting full service from untreated ties which had been used for sills and, while there can be no doubt that treated sills are the better, such a scheme would seem to be of value under many conditions. So far as the bad effect of soil or cinders on plant machinery is concerned this would be largely overcome by the method suggested.

This method proposes that green ties be used as stringers and that, after the stacks resting on them are removed, they be cleaned and placed on seasoning stacks, which will allow them two or three weeks (or other period long enough to allow them to dry out) before treatment. While this would scarcely be possible where long seasoning periods are necessary, it could be used with short seasoning periods,

and as two cents would be ample to cover the cost of cleaning and placing the ties for drying out, there would still be a great saving effected over the use of treated sills.

No matter how thoroughly inspection of ties is conducted, it is seldom that a few ties do not show faults after having been seasoned that were not visible at the time of their inspection, or faults that may develop during seasoning. In any event ties do go bad and have to be discarded before treatment. By carefully watching this feature and collecting such ties, many plants could gradually accumulate a complete set of treated sill ties—the ties so thrown out would naturally be treated as soon as a charge accumulated. Furthermore, most railroads can find along their right of way many rejected ties which could be sent to a treating plant at small additional cost and there treated and used for stringers.

Concrete sills in addition to being expensive would seem to have the further disadvantage of causing lack of flexibility in a yard which was not wholly devoted to cross ties. That is, switch ties, timber, lumber, etc., seldom are received with the same regularity as cross ties, and, furthermore, the lengths vary widely. It would, of course, be possible to construct concrete sills that would be fairly easily portable, but the lighter they would be the more easily they would break. In cold climates breakage would naturally be high and concrete sills would be much more expensive than treated wooden ones. In warmer climates, where shorter seasoning periods are necessary, concrete sills would be less liable to breakage, but would still be more expensive than treated sills, and they, in turn, would be more expensive than untreated sills when used as suggested.

(The discussion on Mr. Angier's paper, "Sill Ties," was submitted to Mr. Harrington Emerson for perusal. Mr. Emerson kindly reviewed the remarks made and submitted the following analysis in answer to this discussion.)

DISCUSSION ON SILL TIES.

By Harrington Emerson.

The cost of maintenance of ties of any kind depends on four facts:

(1) Total cost of tie in place.

(2) Rate of interest and taxes charged on cost of tie in place.

(3) Life of tie (in use).

(4) Reclamation value of tie when removed.

Comparing the cost of sill ties:

(1) Untreated green.
(75 per cent. firsts, 25 per cent. seconds.)

(2) Treated seconds.

(3) Concrete.

Assumptions as to untreated green ties used for sills:

(a)	That 2 per cent. are rendered worthless.	
(b)	10 per cent. of the firsts are made seconds.	
(c)	12,000 ties required.	
(d)	Turning over and cleaning	$60.00
(e)	Restacking yard for locating sills	30.00
(f)	Disposing of worthless ties	6.00
		$96.00

Cost of untreated green ties for sills:[1]

9,000 firsts at $0.60	$5,400
3,000 seconds at $0.40	1,200
Placing 12,000 ties as sills	120
	$6,720

Reclamation value:

12,000 ties less 2 per cent.	11,760 ties	
11,760	8,820 firsts	
	2,940 seconds	
10 per cent. of 8,820 are made No. 2.		
8,820-882=7,938x$0.60		$4,762.80
2,940×882=3,822x$0.40		1,528.80
		$6,291.60
7 per cent. interest and taxes for 6 months or .035 per cent.		220.21
		$6,511.81

Deduct:

For turning over and cleaning	$60.00	
For restacking yard	30.00	
For disposing of worthless ties	6.00	
	$96.00	96.00
		$6,415.81

Permanent investment	$6,720.00
Reclamation value	6,415.81
Loss in 6 months	$ 304.19
Loss in 1 year	608.38
Loss in 1 year per tie	0.0507
7 per cent. interest and taxes on $\frac{\$6,720}{12,000}$	0.0392
Total loss per tie per year	$0.0899
Cost for 12,000 ties	$1,078.80

Cost of treated ties for sills:

12,000 seconds at $0.40	$4,800
7 per cent. interest and taxes for 6 months (while seasoning)	168
Treating 12,000x$0.18	2,160
Placing as sills 12,000x$0.01	120
Total cost in place	$7,248

Assume a life of 20 years:

Renewal cost per tie per year	$0.03020
Interest and taxes 7% on $\frac{\$7,248}{12,000}$	0.04228
Total cost per tie per year	$0.07248
Total cost for 12,000 ties per year	$869.76

Cost of concrete ties for sill ties:

First cost, $0.80 x 12,000 ties	$9,600
Labor placing	300
Total first cost 12,000 ties	$9,900

Assume a life of 25 years:

Cost per tie per year	$0.03300
Interest and taxes 7% on $\frac{\$9,900}{12,000}$	0.05775
Total cost per tie per year	$0.09075
Total cost for 12,000 ties per year	$1,089.00

Summary for 12,000 Sill Ties.

	Cost per Tie per Year.	Total Annual Cost.
Untreated green	$0.08990	$1,078.80
Treated	0.07248	869.76
Concrete	0.09075	1,089.00

Treatment would have to cost over $0.33 per tie to make treated sills equal annual cost of concrete ties.

Treatment would have to cost over $0.32 per tie to make treated sills equal annual cost of untreated sills.

CHAIRMAN CRAWFORD: This is an interesting subject and it is too bad we cannot continue the discussion for a greater length of time. If there is nothing further we will now take up Mr. Christian's paper.

DESTRUCTION OF TIMBER BY MARINE BORERS.

By E. S. Christian.

It is conceded that marine borers do not thrive in foul water, and that they prefer the uncontaminated water of the ocean, hence, Hampton Roads, which is an arm of the Atlantic, connecting that ocean with the James and Nansemond Rivers, offers an ideal environment for the growth of the Teredo and its kindred borers.

I have frequently seen specimens of Xylotrya and other Teredo three feet in length and five-eighths of an inch in diameter, although the more destructive borer is much smaller and by far more numerous.

In this connection, the history of the Chesapeake & Ohio pier No. 6, formerly No. 1, at Newport News, Va., on Hampton Roads just below the mouth of the James River is interesting; not only because it tells the story of how timber treated with twelve pounds of Dead Oil per cubic foot has withstood the attacks of marine borers for 32 years, but it also tells that in these same waters timber not creosoted was destroyed in two years. It also records the unique fact that the writer, and I think he is the last of the old timers, not only creosoted these piles and drove them, but has from time to time withdrawn one and extracted the oil for a check analysis with the original.

This pier is 800 feet long and 200 feet in width and requiring about 4,000 piles, was first built in the year 1879 on charred pine and cypress piles. Charring at that time was thought to make timber immune from all marine borers, but upon examination one year later the piles were found to be damaged to such an extent as to make the pier unsafe.

Fig. No. 1.

After wasting much time and money experimenting with patented substitutes, a contract was entered into with Mr. E. R. Andrews, of Boston, a protege of the Bethels, of Becton, England, to move his experimental creosoting plant from Boston to Money Point and to supervise the construction of a new plant at that place. This plant was completed in the early autumn of 1882 and the first creosoted piles used on the Atlantic coast were treated there and used in re-building this pier in October of the same year, the construction being completed in February of 1883.

The writer was appointed inspector on that work, probably for the same reason that many young men are now appointed, but he inspected and obeyed his orders, which were to see as far as possible, that every cubic foot of each of the 4,000 piles absorbed twelve pounds of oil. One of the tests made to determine this, was to bore each pile in six places and if any boring showed a penetration of less than one and one-half inches, the pile was rejected and treated again.

The oil was bought by the Railroad Company under the following specifications:

Fig. No. 2.

"It must be distilled from the coal tar derived from New-castle coal, and must be of a greenish yellow color when liquified.

It shall not contain any water.

Not over eight per cent. (8%) of tar acids,

Not less than sixty per cent. (60%) of Naphthalene,

Not less than twenty per cent. (20%) of Anthracene and Anthracene Oil.

Not less than five per cent. (5%) shall remain in the flask after it has been heated to a temperature of 320° C."

This analysis was very simple, and it required but a short time to make, because there was no reason, in those days, to suspect adulteration by the mixing of asphalt, petroleum, water gas tar, or any of the other numerous adulterants which are sometimes found nowadays.

The London Gas Light and Coke Company furnished the specifications and supplied the oil which was always uniform in quality and was delivered in barrels, although Naphthalene was sometimes delivered in bags and mixed with the oil whenever it was found necessary to increase that fraction.

If creosoting plants could get the prices paid in 1882, there would be no need of Inspectors to watch us as we could afford to be honest, for not only was all timber and oil furnished by the Railroads and

Fig. No. 3.

delivered to Money Point, but the creosoted timber was paid for at the rate of twenty-five cents per cubic foot, f. o. b. the works.

This pier required 4,000 piles from forty to one hundred feet long, and is to-day, thirty-two years after it was rebuilt on creosoted piles, in daily use as one of the fourteen units which comprise the magnificent terminals of this great railroad at Newport News.

Figure No. 1 shows a cross section of one of the original charred piles, and figure No. 2 shows two pieces of the same piles on the bottom row, and three pieces, two on end and one standing, of a creosoted eighty foot pile taken from this pier in 1912.

There were three other sections taken from this same pile and sent to three chemists to determine the quantity and which fractions of the oil remained, and it is very interesting to know that after thirty years' service, there remained ten and one-half of the original twelve pounds of oil, and of this quantity, fifty-five per cent. was Naphthalene. All of these pieces were taken from that part of the pile between the high water and the mud lines.

Fig. No. 4.

At the present time and for some years back, I have recommended **sixteen** pounds of oil per cubic foot for marine work in Hampton Roads because of the difficulty in obtaining oil with more than thirty-five per cent. of Naphthalene. I know that when advocating this latter fraction, I am at variance with a great deal of expert opinion, but my experience tells me that I am right. I believe however, that in the treatment of cross ties and bridge timbers, the Naphthalene fraction may be lowered providing that the percentage of pitch is increased.

It is well to note that piles not creosoted, when used in Hampton Roads or its adjacent waters, will be destroyed by marine insects in two years. I have known of untreated piles driven in April near the Virginia Railway piers, to be entirely destroyed at the low water mark by the following September. It is, however, a well known fact that the destructiveness of the Teredo will vary from one year to another.

This variation is noticeable particularly on the Atlantic coast north of Hatteras, and is influenced by the temperature of the water. South of that point the ocean water has very little temperature variation

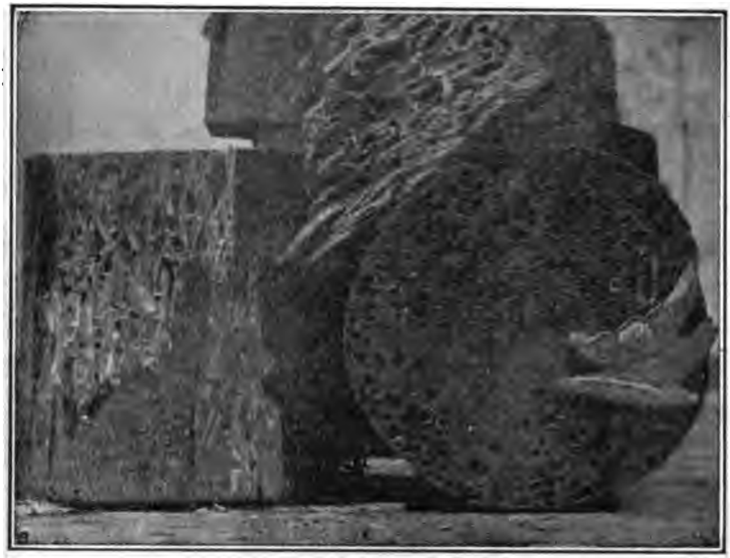

Fig. No. 5.

owing to the influence of the Gulf Stream, therefore timber for marine work requires a greater quantity of oil per cubic foot than for similar work north of that point. There are some exceptions to this rule influenced by local conditions; for instance, timber used in the waters around Beaufort, N. C., should be treated with not less than twenty-four pounds per cubic foot, which is the quantity I should recommend for Fernandina, Fla.

Figure No. 3 shows two sections of same pile uncreosoted, that was in Beaufort Bay for three years. Figure No. 4 shows two sections of the same pile in Beaufort Bay for sixteen years. This pile was treated with twenty-four pounds of Dead Oil containing fifty-five per cent. Naphthalene.

Another illustration of the value of timber treated with oil containing over fifty per cent. Naphthalene, is found in the Manatee River bridge on the West coast of Florida, built by the Seaboard Air Line Railway in 1900. In that year the above railroad in extending its line south from Tampa, found it necessary to cross this river. The Chief Engineer at that time, Col. W. W. Gwathmey, consulted me as to the advisability of using creosoted piles, and at the same time warned me that the Government Engineer in command in that district who had had a great deal of experience in the use of creosoted timber on the West coast, advised against his using it and stated that it would not

Fig. No. 6.

last three years. Knowing, however, that his experience was based entirely on long leaf pine indifferently treated, I assured Col. Gwathmey that sap pine treated with twenty-five pounds of oil per cubic foot would stand, and now, after fourteen years, I am assured that these piles are in perfect condition.

In Figure No. 5 is shown four sections of an untreated pile after two years service in this river.

Figure No. 6 shows the top of a creosoted fender pile driven twenty-years ago in the harbor of Halifax, N. S., and is shown as evidence of neglect.

This pile was treated with twelve pounds of oil, and if one and one-quarter inch had been bored through the center for twelve inches or more, and this filled with hot oil two or three times the first year, this part of the pile would have been as solid as the two sections, one end view and one standing, shown in figure No. 7, which is part of the same pile at the mud line.

Fig. No. 7.

Fig. No. 8.

The solid part of this pile was a cylinder about twenty-five feet long, which was the distance from the top to the low water mark, and the thickness was measured by the oil penetration, about one and one-half inches.

The two sections of the pile mentioned above in figure No. 7 were in perfect condition although both teredo and limnoria are active in those waters as shown by the two bottom pieces of untreated piling picked up in the same harbor.

Figure No. 8 represents a bulk head built four years ago in a bay having direct connection with the Atlantic, and about 250 miles north of Cape Charles.

The contract was for 3" x 10" tongue and grooved short leaf pine treated with sixteen pounds of Dead Oil per cubic foot of standard quality. My Company bid on this contract, and in the interest of economy, recommended twelve pounds of oil as being sufficient.

The contract was given to a competitor, and the inspection was done by one of the important Engineering Laboratories.

The present Engineer sent me this sample to find out what it was treated with, and after exhausting every effort to find a trace of Creosote Oil, I determined that the discoloration is due to a mixture of water and lamp black.

These illustrations telling how timber properly treated has successfully withstood the attacks of marine borers, could be shown indefinitely, for in my thirty-two years experience in the handling of creosoted timber, I do not know of a single instance of failure, provided the necessary quantity of oil of standard quality was injected into the timber.

I have however, known of many instances where creosoting did not protect timber from the teredo and its kindred, but in every instance, the failure could be traced to either ignorance on the part of the Engineer in not specifying sufficient oil, or knavery on the part of the creosoting plant in not complying with the specifications.

In the old days contracts for creosoted material were made by the engineers with the treating plants, but now the engineers occupy their valuable time writing voluminous specifications, and they will send young men of no experience, to see that the work is properly done.

DISCUSSION ON DESTRUCTION OF TIMBER BY MARINE BORERS.

By J. C. Williams.

There are two papers prepared for this Convention which stand out prominently in the program and which to my mind mark this Con-

vention as the most valuable, important and progressive of any that has ever been held.

These two papers, which seem to me to be so exceedingly valuable, are Mr. Christian's paper, which we are now discussing, and Messrs. von Schrenk and Kammerer's paper entitled "A Specification for a Coal-Tar Creosote Solution."

I will venture to say that this is the first convention of this Association where the question of commercial expediency has been raised and recognized as it is in these two papers.

There is scarcely a man present, certainly no member of the Association, who does not at least know of Mr. Christian by reputation. He says he is the last of the old-timers but to those of us who have more than a casual acquaintance with him and who have tried the sincerity of his words by years of observation and by personal association in his daily work (I speak now of the early days of my own experience when I was beginning as an inspector, the same way that he did before me way back in the early '80's) he looms up as a commanding figure in the industry, and we know that he is too modest in his estimate of the position he holds in the wood-preserving world today, and no contemporary will gainsay him the title of the "Nestor of Wood-Preserving." If his ideas and experiences, supported by the tests and observations he has made, do not square with the theories with which we have had so much to do recently, then I can heartily say, "so much the worse for the theorists."

One or two incidental paragraphs in the paper under discussion can well be emphasized.

The first of these is the neglect of treated timber due to failure to properly take care of exposed surfaces which are the result of necessary cutting. Just how we are going to compel the ordinary contractor, or owner for that matter, to look after these details, I do not know, but there is no doubt in my mind that there are many more failures due to this cause than are due to ignorance or chicanery on the part of the creosoter.

Mr. Christian's mention of the sheet piling treated with water and lamp black brings to mind the practice of a local New York contractor, now dead, who, whenever he had to furnish any creosoted timber, used to raft his material for several weeks in the dirty waters of one of the creeks tributary to New York harbor.

His theory was that the sewage and refuse oils in the water would make the material black and greasy and the leakage from a nearby creosoting works finding its way into the creek adhered to the surface of the lumber and furnished the necessary smell.

Speaking seriously, the paper appeals to me as a clarion call guiding us back out of the fog of theory and experiment to the old moor-

ing posts of good creosoting based on "the necessary quantity of oil of standard quality."

There is still one other point that I wish to touch on, and that is the matter of prices to which he refers.

It is, of course, impossible to get back to conditions as they were in 1882, but the present practice, indulged in by many salesmen, endeavoring to discover what the low price is and then quoting a fraction lower regardless of the relation of these figures to their cost of production, can only result in one thing, and that is it keeps the man who is willing to do this continually loaded up with cheap business and his competitors are practically doing his figuring for him.

Naturally they are not going to figure any profit for the man who gets his business this way if they can avoid it, and the result is a continuous and cumulative lowering of prices with its concomitant evils of slipshod work which eventually reflects disgracefully on the business generally, and which, in turn, encourages the use of concrete or other types of construction as a substitute for creosoted lumber.

The remedy for this is for each one to adopt a strict system of cost-keeping, knowing to the nearest cent per thousand feet, board measure, the nearest ten-thousandth of a cent per lineal foot of piling and the nearest tenth of a cent per tie what each operation costs, and quoting prices based on these costs plus a fair manufacturer's profit, and adhering to these figures when made.

Then with the work going to the original low bidder, if there be any who are at present figuring on a wrong basis, they will learn from experience that they cannot do what they expect and will be compelled to advance their bids, which will then develop the new competition of quality of work, service and delivery.

Still another bad feature of "price-competition-regardless-of-cost" is that each time a contract is taken away from an original low bidder by the expedient of underbidding he is kept in the market as an active competitor for future business, whereas with some work on his hands he ceases to be a disturbing factor.

Experience teaches that there has never yet been a wood-preserving plant built and operated that was forced to close down by price-cutting, and the sooner we recognize this fact and adopt a "live-and-let-live policy," which will permit the handling of the work at prices which will warrant it being done thoroughly, the better it will be for all and the less we will have to contend with in the way of voluminous specifications, which are merely the engineer's way of protesting against the skimping methods of some plants which seem to sell on the principle of any price to keep the other fellow out, and then skimp their work in order to come out even.

MR. T. G. TOWNSEND: I would like to present the following discussion:

ATTACK OF MARINE BORERS ON CREOSOTED MATERIAL.

By T. G. Townsend.

There are three borers which will be taken up in this paper: The Xylotrya, Limnoria and Sphaeroma.

The Xylotrya, usually called Teredo, or ship worm, is perhaps the best known and needs no description. Its attack runs from mud line to about high tide.

The Limnoria is probably nearly as well known. This is a small, brownish-white bug, the length being less than 1-16 inch. This bug works from high tide to the mud line in Pensacola and Galveston Bay, and probably as deep in other harbors, their worst attack being between high and low water. They attack wood in countless numbers, and in

Tampa, Fla.—Pile creosoted 1910; attacked by Sphaeroma.

untreated wood they work quite rapidly. They make small holes, mostly in the springwood, leaving layers of summerwood which the action of the water breaks off. The attack of these bugs is varied and apparently at random. It is sometimes uniform all around the surface

Pensacola, Fla.—Creosoted 1899. Some destroyed, others not so badly attacked by Xylotrya. Shows variation in attack of Xylotrya. Sometimes attack extends throughout the pile, at others is confined to the surface.

of the pile from high to low water, while again it is in streaks, both large and small in area. Sometimes they form holes on one side of the pile with no attack on the other. Some attacks start in streaks and later join inside the pile, leaving unattacked strips on the surface. No particular reason is known to the author why attack should sometimes be found on one side of the pile with none on the other. In some places Limnoria make untreated piles unserviceable in one or two years, the two worst places I have visited being Charleston and Brunswick.

Sphaeroma are perhaps not so well known, their work being confused with old Teredo holes.

The Sphaeroma is a small bug somewhat similar to the Limnoria, but much larger and heavier, the largest being about ¼ long and ⅛ inch wide, and of a dark color. They work something like the Limnoria, but are not so numerous, and, consequently, the damage done is much slower. They work in either salt or fresh water. They are numerous in Brunswick, Tampa, the St. John's River, at Mayport, Fla., two miles from the mouth; Jacksonville, 25 miles from the mouth, and are at Palatka, about 100 miles from the mouth, and in fresh water, and also in tributaries to this river. Besides working in wood, they are also found in a sort of soft stone composed of sand and dirt near the mouth of the Ft. George River, near Mayport. While the Teredo start with small pin-holes in wood, growing larger rapidly in diameter to the first inch in length and lining the holes with a calcareous coating, the Sphaeroma holes are uniform in diameter with no

Charleston, S. C.—Thirty to thirty-five-year piles. All creosoted. Attacked mostly by Limnoria.

Charleston, S. C.—Thirty to thirty-five-year piles. All creosoted. Attacked mostly by Limnoria.

Charleston, S. C.—Creosoted center pile destroyed by Limnoria and Xylotrya. Driven about 1911.

Charleston, S. C.—Thirty to thirty-five-year piles. All creosoted. Attacked mostly by Limnoria.

Charleston, S. C.—Creosoted center pile destroyed by Limnoria and Xylotrya. Driven about 1911.

lining. An old attack in wood can usually be distinguished in this way.

It would take probably 5 years or more for the Sphaeroma to render an untreated pile unfit for service. There are small untreated docks around Jacksonville which are infested with Sphaeroma and have been in service long enough for the sap above the water to rot. The vitality of these bugs is remarkable. One was placed in creosote and lived 15 minutes, and the average of about six others was 20 minutes in alcohol. They live several days out of water if kept moist.

The fact that creosote piling is not wholly immune from attack by marine borers is evidenced by the attack and destruction of well-creosoted piles, is quite general and is a serious problem in some localities. The attack of these three borers in creosoted material is in general the same as in untreated material except that it is slower. The

Mayport, Fla.—Piles creosoted 1901. Attacked by Sphaeroma.

reason for attack cannot be assigned to poor work or poor oil at any particular plant, because piles coming from six plants which have furnished most of the piling for the South Atlantic and Gulf Coasts have been found to be attacked and many of them heavily. The treatments run up to 22 pounds per cubic foot. In Charleston all groups of creosoted piles over 2 years old showed some attack. Some of

these were attacked so heavily that they were rendered useless within 3 years. Some of the oil used probably contained a good deal of naphthalene. English oil was also generally used in 1909 to 1912, which distilled about 30 per cent. to 235° C.

There are 200 or more piles treated at an abandoned plant at Summerville, S. C., 30 to 35 years ago, which are still in service in Charleston and which are in remarkable condition considering their age. These piles had been boxed for turpentine and had butts about 14 to 16 inch diameter. I do not know the treatment of these piles.

In Gulfport piles treated with 18 to 20 pounds of creosote have been heavily attacked by Xylotrya and some Sphaeroma. In Brunswick longleaf piles, treated with 16 pounds of creosote in 1909, have been attacked by Limnoria, and piles treated at the end of 1907 and laid on the bank for a year before driving them have been destroyed by Limnoria and Xylotrya. The Sphaeroma there are not bothersome,

Brunswick, Ga.—Pile creosoted 1909. Destroyed by Limnoria and Xylotrya. Pile formerly under the corner of dock has been attacked and broken off.

and their attack is mostly at high water. At Charleston the Limnoria are very bad, and while some of the piles have gone 3 years without much attack there are others treated about the same time by the same plant for another dock which are practically destroyed. The Xylotrya

here do not show above the water in treated piles, although they are plentiful in untreated material. Perhaps the reason is that the Limnoria keep them out. They may be in treated piles below water, but it is impossible to tell from a boat.

At Mayport, on the St. John's River, creosoted piles treated in 1901 with 20 pounds have withstood the attack of Sphaeroma and Xylotrya pretty well, although a number of them have been destroyed. Some of the piles at Tampa, which are about 5 years old, are showing attack

Brunswick, Ga.—Pile in foreground creosoted October, 1907. Driven about April, 1909. Destroyed by Limnoria and Xylotrya. Plank in foreground not treated.

by Sphaeroma. Fifteen-year-old piles at Pensacola are still in service, although many of them have attack all the way through by Xylotrya.

Although examinations made thus far show that all classes of creosoted piles may be ultimately attacked, three reasons for rapid attack may be stated:

(1) Inner skin left on the pile during treatment cannot be penetrated and will cause an untreated strip of wood extending to the heart, in which the borers can penetrate readily.

(2) Uneven penetration due to water and resin pockets coming close to the surface will also leave an untreated place for the borers

to work readily after the attack reaches it. This often occurs even when the outer ½ inch or more is well saturated with oil.

(3) Abrasions, scars, etc., are probable places of early attack. Cuts made for bolts and washers are very bad. Several well-treated 22-pound piles are cut into to make room for washers and nuts for bolts which

Brunswick, Ga.—Piles treated either 1907 or 1909. Heavily attacked by Xylotrya and Limnoria.

were too short for the piles. These places were not protected with anything, and at the end of the second summer Limnoria and Xylotrya had started into them. One place which was broken up by the rough chopping had Limnoria in the treated part. There was no evidence yet of borers in the piles which had not been damaged.

The attack by Limnoria is said to be getting worse in Charleston. The instances mentioned are by no means isolated cases, but just show the general condition in those harbors. How serious this attack is can only be realized by personal examination of docks in the territory covered by these borers.

MR. T. G. TOWNSEND (Continuing): I have some samples which I would like to show. In every sample the borers have been

working in well-creosoted wood. These are from piles 30 to 35 years old at Charleston. The attack on them is Limnoria, and part of one of the samples looks as if it is the original outside surface of the pile. I do not think that much could be found out by extracting the oil as untreated piling are attacked in a similar manner. These other samples are from piles treated in the spring of 1909 with an oil supposed to be high in naphthalene and driven soon after arrival at the dock. They have been attacked by Limnoria, Sphaeroma and Xylotrya, all three being in some of the samples, and have gone into well-treated sapwood. The Xylotrya generally work near the surface of a creosoted pile, and when a layer is broken off go in a little deeper. I will be glad to show these samples to anyone after the meeting has adjourned.

CHAIRMAN CRAWFORD: This is a lot of valuable information that Mr. Townsend has given us, and if there is nothing further on this subject we will ask Mr. Cherrington to read his paper now.

MR. FRANK W. CHERRINGTON: Mr. President and gentlemen: I do not believe it is necessary to read this paper, inasmuch as our time is becoming very limited. It contains, perhaps, nothing new or startling and was written merely for the purpose of emphasizing the importance of plant inspection of the treated material. Engineers inexperienced in this line of work often condemn, because of laboratory tests, material which has been treated strictly in accordance with their specifications, and this subject is brought up for the purpose of discussion more than anything else.

LABORATORY ANALYSIS AFTER TREATMENT VERSUS ACTUAL RECORD DURING TREATMENT OF CREOSOTED WOOD PAVING BLOCKS.

By Frank W. Cherrington.

Is the collection and analysis of creosote oil, extracted from creosoted wood paving blocks after treatment, a reliable calculation as to the initial quantity actually injected inside the blocks, during the process of treatment?

The desired degree of accuracy, relating to the *average* quantity of injected creosote oil per cubic foot of timber, cannot be reached by the laboratory extraction and analysis of creosote oil, after its injection into wood.

Owing to the remarkable variation in the structure of wood it is only possible to accurately determine the *average* quantity of creosote oil injected per cubic foot of timber, by close observations of the proper treating gages, and automatic recording devices, at the creosoting plant during the actual process of treatment.

The composition of the timber is of so complex a nature that scarcely two wood paving blocks are identical in structure, even when cut from opposite ends of the same plank of average commercial length. This is true, regardless of the most careful commercial specification as to lumber, limiting the percentage of heartwood, number of annual rings to the inch, etc. Therefore, although treated under the same temperature and same pressure, scarcely two wood paving blocks will have the same degree of penetration or absorption.

The reasons for the variation in the structure of wood blocks sawed from the same species of wood, whether taken from the same tree, or from widely separated growths, are difficult to explain, but a few of the more obvious reasons are here cited.

It is very evident that some of the blocks are necessarily manufactured from timber coming from the heart of the tree and some from the exterior portions of the tree. The even dry weight of sap wood is often but two-thirds that of the heartwood. A cross section of a tree cut from its base will be of an entirely different structure from the cross section cut from the middle or top. Timber growing on the side of a hill will be different from that growing on high or low ground. Some trees will grow at the edge of the forest and others in the interior. A piece of timber cut from the north side of a tree will show a different structure from that cut from the south side. A rapidly growing tree will have a different structure than that of a slow growth timber of the same species. Thus it is seen that environment is largely responsible for the complexities in the wood structure of a tree.

A quotation from Bulletin 101 of the Forest Service, United States Department of Agriculture, relating to "The relative resistance of various conifers to injection with creosote," follows:

"It is very difficult and sometimes apparently impossible to secure uniform treatments of wood with preservatives. If, for example, an average treatment is given of ten pounds of creosote per cubic foot, some pieces of wood in a charge will receive twice the average amount, while others will receive less than half of it."

An average carload of creosoted wood paving blocks will contain approximately 300 sq. yds., or 15,000 individual blocks. The chemist in making analysis after the blocks are treated and have arrived on the work, selects perhaps a dozen, but rarely two dozen, blocks from the car at random. The creosote oil is then extracted and analyzed as to both quantity and quality, and the result accepted as the average oil content per cubic foot in the 14,976 other blocks. If as many as two dozen blocks are selected out of the entire car, as samples, they will represent but .16 of 1 per cent. of the total number of blocks in the car.

The Government Bulletin above referred to also states that "In general longleaf pine was found to be erratic in its penetration and absorption of creosote."

The above citation from the Government and the listing of but a few of the factors affecting the structure of wood proves the futility of selecting a few wood paving blocks for analysis, after the injection of the oil, as representative of the average penetration and quantity of oil that may be secured on the entire car. The blocks selected for analysis may be all heart or all sap, with large or small quantities of resin, etc., and the chance of a wide deviation from the true average is great.

The final result obtained from a laboratory analysis is liable to be in error. The human element, volatility of the creosote oil, difficulty in separating the injected creosote oil from the natural resin, impossibility of extracting all of the injected oil, etc., etc., all tend to reduce the precision of the result. The possibility of an error in laboratory extraction and analysis, combined with the variation of the wood structure, doubles the chance for inaccuracy and detracts from a précise estimation of the average amount of creosote oil initially injected into the wood.

Records showing the average quantity of creosote oil actually injected into the wood blocks at the plant during the treatment, when compared with the results showing the amount of oil extracted by laboratory analysis from selected samples, representing an exceedingly small proportion of the entire number of blocks treated, will naturally show a decided variation.

When laboratory analyses are accepted by the consumer as absolutely conclusive, regardless of whether or not an inspector has been present to check the actual injection of the oil at the plant, creosoted wood blocks are often rejected, when the manufacturer has conscientiously and closely followed the required specification.

Directly bearing on this subject is the following excerpt taken from a report by Wm. W. Marr, Assistant Engineer of Streets, Board of Local Improvements, Chicago, Ill., entitled "Repaving the 'Loop' District in Chicago with Creosoted Wood Blocks," which of course, anticipates a proper selection of the timber, oil and treatment, in accordance with good practice:

"Many blocks, on being split for the purpose of making mitres or closures, show white on the inside and appear to have received very little treatment. This is a cause of a great deal of complaint from those who are not familiar with the reason for blocks having this appearance. As a very great number of blocks are treated at one time, it is not reasonable to suppose that a few blocks could have received a less pressure and treatment than the balance of the blocks received; so

it can safely be assumed that the blocks which do not show so great a penetration as the rest are simply incapable of taking the oil on account of their pores being already filled with resin. Blocks of this sort have never given any trouble and are consequently never rejected."

Modern creosoting methods employ the treatment at one time of some thirty thousand (30,000) individual and very different paving blocks. These are placed in the same creosoting cylinder and subjected to the same temperature and same pressure. It is impossible to give each block an individual treatment, and since blocks of varying structure must be treated collectively, it is but consistent to insist that an extremely small proportion of the whole, selected at random for analysis, can *not* be conclusively indicative of the average absorption secured by the treating plant engineer on the entire charge.

CHAIRMAN CRAWFORD: No doubt most of you have read this paper by Mr. Cherrington. Is there any discussion or comments on it?

This brings us to the program for this forenoon on wood block paving. We will now ask the Committee to come forward and present its report on Wood Block Paving.

REPORT OF COMMITTEE ON WOOD BLOCK PAVING.

To the Members of the American Wood Preservers' Association:

Your Committee on Wood Block Paving was assigned the following subject: "To prepare a comprehensive history of wood block paving in the United States." In preparing this history the Committee has endeavored to confine itself to statements of historical events. Recommendations or opinions have been eliminated as far as possible, and this Committee does not accept responsibility for any interpretations of statements in the report that would place us in the position of making recommendations.

Last year the Association approved this Committee's report which stated that the specification (see Page 217, 1914 Proceedings) of the Association for Standardizing Paving Specifications is a safe one to use, with the exception of the use of the water-gas-tar products, and with the additional recommendation that bituminous fillers be used in the joints of blocks. That Association has amalgamated with the American Society for Municipal Improvements, which also had a specification for wood block paving. It resulted, therefore, that the latter Association had two specifications on wood blocks. At their convention in Boston last October their committee on wood block paving prepared a new specification which differed from the former ones in sev-

eral important respects. Since this was considered a very important specification, and because of some important changes which the committee made, it was recommended that these specifications be printed in the Proceedings and that no action be taken on them before the convention in October, 1915.

A copy of their tentative specifications is attached to our report. It contains some points with which your Committee does not wholly agree. In general, however, it could be used as the basis for our specifications.

Your Committee, therefore, makes the following recommendations:

1. That at the next convention of this Association your Committee be instructed to present a specification for wood block.
2. That the Committee on Preservatives be instructed to present a specification for paving oil.
3. That the committees be instructed to co-operate with the American Society for Municipal Improvements in drawing up the new specifications and have them identical in wording except on points wherein we may not agree with them.
4. In case the above recommendations are approved, the members of the Association interested in this subject are requested to carefully read the tentative specification of the American Society for Municipal Improvements attached to this report and to communicate with the Chairman of this Committee concerning any comments or criticisms they may have.

CLYDE H. TEESDALE, *Chairman*,
F. P. HAMILTON,
G. H. DAVIS,
H. S. LOUD,
W. C. MEREDITH,
Committee.

SPECIFICATIONS FOR CREOSOTED WOOD BLOCK PAVEMENT

Recommended by Committee on Standard Specifications, American Society for Municipal Improvements, October, 1914.

Timber.

The Wood to be treated shall be Southern Yellow Pine, Norway Pine, Douglas Fir or Tamarack, but only one kind of wood to be used in any one contract.

The blocks must be cut from good grade of timber, which must be well manufactured, full size, square butted and square edges, free from the following defects: Checks, unsound, loose or hollow knots, knot holes, worm holes, through shakes and round shakes that show on the surface. The annular rings in the 1-inch, which begins one inch from the center of the heart of the block, shall not be less than six. In case the block does not contain the heart, the 1-inch to be used shall begin with the annular ring which is nearest the center of the heart. No block shall contain less than fifty (50) per cent. of heart wood.

Size of Blocks.

The blocks shall be from five (5) to ten (10) inches long, but shall average eight (8) inches. The depth of the blocks should be four (4) inches on all streets where there is any considerable amount of heavy traffic. On lighter traffic streets it may be reduced to three and one-half inches (3½) or to three (3) inches on light traffic or residential streets. In case the blocks are three (3) inches in depth they shall not exceed eight (8) inches in length. They may be from three to four inches in width, but in any one city block all of them shall be of uniform width. A variation of one-sixteenth (1-16) inch shall be allowed in the depth and one-eighth (⅛) inch in the width of the blocks from that specified.

Preservative.

The preservative to be used shall be a product of coal gas or coke oven-tar which shall be free from all adulterations and contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

The specific gravity shall not be less than one and eight-hundredths (1.08) nor more than one and fourteen-hundredths (1.14) at a temperature of thirty-eight (38) degrees Centigrade.

Not more than three and one-half (3½) per cent. shall be insoluble by continuous hot extraction with benzol and chloroform.

On distillation, which shall be made exactly as described in Bulletin No. 65, of the American Railway Engineering and Maintenance of Way Association, as shown in the appendix to these specifications, the distillate based on water free oil shall be within the following limits and an average of a number of tests shall show a mean of these percentages, viz: Up to

150 degrees Centigrade	Nothing must come off.
170 " "	0 to 0.5 per cent.
210 " "	2 to 6 " "
235 " "	8 to 16 " "
315 " "	30 to 45 " "
355 " "	45 to 60 " "

The gravity of distillate distilling between 235° and 315° Centigrade shall be not less than one and two-hundredths (1.02) at sixty (60) degrees Centigrade compared with water at sixty (60) degrees Centigrade.

The preservative shall contain not more than three (3) per cent. of water.

The manufacturer of the blocks shall permit full and complete sampling at all times and places and shall, if required, furnish satisfactory proof of the origin of the preservative.

Treatment.

The blocks shall be treated in an air-tight cylinder with the preservative as heretofore specified. They shall first be subjected to steam at a temperature between 220° F. to 240° F., after which a vacuum of not less than twenty (20) inches shall be drawn and the temperature at the same time maintained at 150° F. to 240° F. While the vacuum is still on, the preservative oil, heated to a temperature of 170° to 200° F., shall be admitted and pressure gradually applied until a sufficient

NOTE.—If a city desires a pure coal tar distillate the material insoluble in benzol and chloroform shall be less than one (1) per cent.

amount of the preservative oil has been forced into the blocks. After this, if it is desired, a supplemental vacuum, steam or both, shall be applied. At the completion of the treatment the blocks shall contain not less than eighteen* (18) pounds of water-free oil per cubic foot of wood contained in that particular charge. Not more than ten (10) per cent. of excess above the amount specified shall be allowed. They shall, after treatment, show satisfactory penetration through and through of the preservative, and all blocks that have been warped, checked or otherwise injured in the process of treatment shall be rejected.

The surface of the blocks shall be clean and free from any deposit of tar or other foreign substance.

Inspection.

The blocks shall be inspected at the plant and the manufacturer of the blocks shall equip his plant with all the necessary gauges, appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled. He shall allow an authorized representative of the city to inspect all materials and all parts of the plant during the manufacture of the paving blocks.

After delivery upon the street the blocks shall be subjected to a further inspection and all imperfect blocks shall be rejected and removed from the street by the contractor.

Foundation.

The base shall be of concrete made in accordance with the specifications of Concrete Paving Foundations and shall be preferably six (6) inches in thickness. At the discretion of the engineers on lighter traffic streets the thickness may be reduced to five (5) inches.

Cushion.

"A"—Sand.

The blocks shall be laid on a sand cushion one (1) inch in thickness spread on the concrete foundation. The sand cushion shall be struck by templates to a surface parallel to the grade and contour of the finished pavement in such a manner that when the blocks are set and properly bedded in the sand the tops shall conform accurately to the finished grade of the pavement. The sand used in this cushion shall all pass a quarter-inch screen and be clean and sharp.

"B"—Mortar.

Upon the concrete foundation shall be spread a layer of mortar one (1) inch in thickness and made of one part of Portland cement of the character provided for use in the foundation and three parts of sand. Only sufficient water shall be added to this mixture to insure a proper setting of the cement, the intention being to produce a granular mixture which may be raked to the desired grade. The mortar shall be thoroughly mixed and shall be spread in place on the foundation, immediately in advance of the block laying, to such a thickness that when the blocks are set and properly bedded in the mortar their tops shall conform accurately to the finished grade of the roadway. The concrete foundation shall be cleaned and swept and shall be thoroughly dampened immediately in advance of placing the mortar bed. The mor-

*NOTE.—This amount may range from sixteen (16) to twenty (20) pounds, at the discretion of the engineer, dependent on local conditions.

tar bed shall be struck by templates to a surface parallel to the grade and contour of the finished pavement.

"C"—Bituminous.

Under special conditions, especially where vibration may be expected, mortar cushion may be omitted and a bituminous coating spread upon a smoothly finished and thoroughly dry concrete base substituted therefor.

Filler.

When the blocks are laid upon the sand cushion the joints between the blocks shall be filled with a suitable bituminous filler.

When the blocks are laid upon a mortar or bituminous cushion the joints may be filled with sand or bituminous filler.

Expansion Joints.

A longitudinal expansion joint not less than three-quarters (¾) of an inch in width and filled with a suitable bituminous filler shall be placed along the curbs.

Laying Blocks.

Upon the bed thus prepared the blocks shall be carefully set, with the fiber of the wood vertical, in straight parallel courses, except that one row of blocks shall be placed parallel with the curb and three-quarters of an inch therefrom.

The blocks shall be laid by setting them loosely together on the cushion coat, but no joint shall be more than one-eighth (⅛) inch in width. Nothing but whole blocks shall be used, except in starting a course or in such other cases as the city may direct, and in no case shall the lap joint be less than two (2) inches. Closures shall be carefully cut and trimmed by experienced men. The portions of the blocks used for closure must be free from check or other fracture, and the cut end must have a surface perpendicular to the top of the block and cut to the proper angle to give a close tight joint.

After the blocks are placed they shall be rolled parallel and diagonal to the curb by a steam roller weighing at least five (5) tons until the surface becomes smooth and is brought truly to the grade and contour of the finished pavement. When laid on a mortar bed the rolling shall be completed before the mortar has set and all mortar that has set before the blocks are in place and rolled shall be discarded and replaced by fresh mortar.

After the blocks have been thoroughly rolled the joints between them shall be filled with the filler selected.

After inspection by the proper city official the surface of the wood block pavement shall be covered to a depth of about one-half (½) inch with fine screened sand. This sand is to be left upon the pavement for such time as may be directed by the proper city official, after which it shall be swept up and taken away by the contractor.

NOTE.—Engineers should not use this specification as a whole, but should make a selection of material and method where more than one is indicated under the different headings.

HISTORY OF TREATED WOOD BLOCK PAVEMENTS IN THE UNITED STATES*

(Supplementing Report of Committee on Wood Block Paving.)

Introduction.

The first use of untreated wood blocks as a paving material in the United States is said to have been in a pavement laid in New York City about 1835. Before 1840 Boston and Philadelphia laid pavements of spruce and hemlock blocks which cost from $2.00 to $2.50 per square yard. The use of untreated wood blocks for pavements was soon taken up by other cities and a large variety of species were employed, such as white pine, hemlock, oak, osage orange, cypress, mesquite, cottonwood, tamarack, Douglas fir, and redwood. Large amounts of round blocks. mostly cedar, were also used, especially throughout the Middle West.

In the early use of wood blocks considerable attention was given to the form of the blocks and a number of these were patented. The Nicholson block, patented in 1848, was extensively used between 1860 and 1870. These blocks were rectangular in shape and gave a much more even surface than many of the other forms used.

During the 60 years preceding the use of treated wood blocks many cities laid large quantities of wood pavements at great expense. These were satisfactory at first, but they soon decayed, and in a comparatively short time after laying they had to be removed. Subsequent to 1871 over 1,000,000 square yards of untreated wood block pavement were laid in the city of Washington, D. C., costing from $2 to $4.20 per square yard. Nearly 30 per cent of this was removed six or seven years after it was laid, and by 1889 the last of the blocks had been removed. Similar trouble was experienced by other cities using untreated wood as a paving material.

In most of the early wood block pavements little care was taken in the selection of the wood used, or in protecting it from decay. Often the blocks were laid on a plank foundation, placed directly on the ground, or upon a sand base, thereby creating a favorable condition for decay.

While both wear and decay are the principal causes of the failure of wood block pavements, decay is by far the most destructive agency. After years of repeated failures attention was directed to the use of wood preservatives.

In 1877 an experimental pavement was laid in St. Louis under the direction of Col. Henry Fladd, which included sections of creosoted pine and Burnettized gum.

*Acknowledgment is due to J. D. MacLean, Forest Products Laboratory, for the assistance rendered in compiling information and in writing this report.

In 1880, 1881 and 1882 a total of 594 squares of sweet gum treated by the Wellhouse process and 632 squares treated by the Thilmany process were laid. The contract price for furnishing the lumber treated and laying the pavement was $18.50 per square for 5-inch blocks.

The first of the Wellhouse blocks were laid on Cherry Street in 1880 on a steep grade. By April, 1882, twenty months after laying, the pavement was entirely broken up. Some of the blocks had worn down to two inches. The failure was laid to the very steep grade and to severe swelling, which tended to disrupt the blocks. Apparently the blocks also failed to wear as well as expected.

In April, 1884, after a service varying from two to three and one-half years, the treated gum blocks were in bad condition, none of them being expected to last more than one year more. The failure was said to be caused by the swelling and shrinking of the blocks due to weather changes. The heartwood of the blocks was sound, but the sapwood was decayed. The blocks did not resist wear under the traffic. Complete reports of treatment, methods of laying and reports of conditions are in the files of the City of St. Louis.

Early Use of Treated Wood Block Pavement in the United States.

One of the first treated wood block pavements was laid in Galveston, Texas, about 1874. A pavement of about 75,000 square yards of longleaf pine blocks was laid at this time and was in service until 1903, when it was removed. It is not thought that these blocks were given the same kind of treatment that is usually given at the present time. They were laid on a sand foundation, no concrete being used. Details of the treatment of these blocks are lacking.

In 1896 Indianapolis laid a few streets with blocks of Washington red cedar. These blocks were thoroughly dried and then placed for six hours in a bath of creosote, which was heated to a temperature of over 210° F. The absorption was estimated to be about three pounds per cubic foot. No expansion joints were used and considerable trouble was experienced on account of swelling. These blocks are still in use and are said to be in a good state of preservation.

It was realized that the best results could not be obtained by dipping the blocks, and in 1898 the first pavement was laid in Indianapolis of blocks treated with creosote under pressure. Longleaf pine was used and was given a treatment of from 10 to 12 pounds per cubic foot. At this time no particular attention was given to the character of the oil. This pavement, although now reported to be in bad condition, gave such good results that city engineers began to appreciate the possibilities of treated wood blocks.

The first wood block pavement used in the East was laid on Tremont street, Boston, in 1900. The blocks were treated by the creo-resinate process, in which a mixture composed of one-half creosote oil and one-half resin was used. The object of adding the resin was to render the blocks more resistant to the absorption of water and to assist in retaining the creosote oil in the wood. This pavement is still in good condition. A sample pavement of this kind was also laid on State Street, Brooklyn, N. Y., in 1902.

In 1899 one of the two roadways on the Rush Street bridge in Chicago was paved with creosoted longleaf yellow pine blocks and the other roadway with untreated blocks. This afforded a good test of wood pavement as the traffic on this bridge was probably heavier than on any other street in Chicago. It was necessary to remove the untreated wood blocks at the end of three years, whereas the creosoted section was in good condition at the end of seven years and gave indications of good service for several years more. They were then taken up on account of the untreated plank foundation being decayed.

One of the first creosoted wood pavements in Chicago was a section of longleaf pine blocks laid in front of the Auditorium Hotel in 1900.

The excellent satisfaction given by these treated pavements, which were largely experimental, resulted in a very rapid increase in the use of wood blocks throughout the country, as shown in the tabulated data presented in this report. The larger cities in particular recognized the merits of wood blocks for streets subjected to heavy traffic as well as for residence streets. Wood pavements in Boston, New York, Chicago, and other cities were installed under severe traffic conditions, where the relative durability could be compared with pavements of other materials on the same street. Many of the other types of pavements which were under similar traffic conditions failed, while wood block remained in good condition. The durability, noiselessness and other desirable features of treated wood blocks have been realized more particularly within the last five or six years.

At present nearly thirty miles of the most heavily traveled streets in Manhattan Borough, New York, are paved with treated wood blocks. In 1912 New York laid about 250,000 square yards and over 200,000 square yards in 1913. Chicago had over 600,000 square yards in 1912 and laid over 165,000 square yards more in 1913.

Minneapolis was one of the pioneer cities in the use of treated wood pavements, and has probably laid as much as any city in the country. This city already has over 1,000,000 square yards and expects to add about 175,000 square yards in 1914. St. Paul, Minn., has planned to lay more than 266,000 square yards during 1914. By January 1, 1914, Detroit had over 458,000 square yards of treated wood pavement, hav-

ing laid over 166,000 square yards of this in 1913. A number of other cities are also laying large amounts of wood block pavement each year.

Development of the Modern Treated Wood Pavement.

Species of Wood.

Southern longleaf yellow pine was most used in the earlier treated wood pavements. This wood has been found by experience to give excellent satisfaction and is most largely used at the present time. Other species that have been used are tamarack, Douglas fir, hemlock, Norway pine, maple, and black gum.

The species most generally admitted by various specifications comprise longleaf yellow pine, Norway pine, and tamarack. Black gum has been used to some extent in the East, but it is claimed that this species has not been entirely satisfactory. Douglas fir is used to a considerable extent in the far West.

Tamarack has been used in several cities and has given good satisfaction. In order to obtain more complete knowledge on the relative value of the various species of wood for paving purposes, the United States Forest Service laid an experimental pavement in co-operation with the city of Minneapolis in 1906. The woods used in the experiment were creosoted longleaf pine, tamarack, Norway pine, Douglas fir, western larch, white birch and hemlock. Longleaf pine was used as a basis of comparison for the other species. The last inspection was made July 15, 1914, eight years after the pavement was laid. From the results of this inspection the species may be classified in the order of their efficiency in this pavement in the following order:

1. Longleaf pine.
2. White birch.
3. Eastern hemlock, tamarack.
4. Norway pine.
5. Western larch.
6. Douglas fir.*

Undoubtedly, there are a number of species of wood that would make satisfactory paving material, but on account of the incomplete knowledge of their value city engineers prefer a wood that has been tried and proved satisfactory. It seems probable that other species will in time be used more extensively than at present. The proper selection of the species of wood used for paving purposes is most important as it determines, to a large extent, the wearing qualities of the pavement.

*The Douglas fir blocks were removed in 1911. The material used was of rapid growth and was improperly treated, thus resulting in the failure of this section.

Depth of Blocks.

Recently there has been a tendency to reduce the depths of the blocks and at the present time 3½-inch blocks are frequently specified, and even 3-inch blocks.

New York City has adopted a 4¼-inch deep block as standard in Manhattan where it has been demonstrated that a 3½-inch block is not strong enough to withstand the heavy traffic. The Borough of Richmond (Staten Island) uses 3-inch block as standard. The Borough of Queens has some of the best wood-block pavement in this country and after nearly ten years service 3-inch deep blocks show practically no wear. The traffic is plentiful, but the vehicles not very heavy.

The blocks used in the early pavements were generally 4 inches wide. In more recent practice the width has often been reduced to 3 inches. This prevents the blocks being laid on their sides. The permissible length varies from 5 or 6 inches to 10 inches.

Specifications generally require that the blocks shall be sound, free from large or loose knots, shakes and other defects of that nature. There are differences in the number of rings per inch specified and in the amount of sapwood that is permissible. Some engineers allow the use of blocks having five or six rings per inch and others specify not less than eight or nine.

The amount of sapwood allowed usually varies from 10 to 40 per cent. In the early use of treated wood blocks, specifications were more rigid in the requirement of a larger percentage of heartwood. Experience seems to indicate, however, that treated blocks having both sapwood and heartwood show no noticeable differences in wearing qualities from those without sapwood.

Preservatives.

The earlier wood paving blocks were treated with a light grade of creosote oil. Later, due largely to expansion difficulties, varying amounts of tar were added. The bleeding trouble has recently led some cities, notably Chicago, to specify a very high-boiling creosote free from tar. This oil has the disadvantage of being high in cost.

Most of the cities in the United States are now using an oil having a specific gravity of 1.10 to 1.14, and containing a large proportion of tar, usually required to be nearly free from carbon. Such an oil is also permitted in the specifications for paving oils of the representative societies interested in this subject.

There is a difference of opinion as to whether oil from water-gas-tar should be used. It is claimed that this cheaper product might be mixed with coal-tar oils without lessening the value of the pavement. Several experimental pavements have been laid using this product, and

until the results of these experiments become available most engineers prefer to exclude water-gas creosote from their specifications.

Method of Treatment.

The earlier pavements were treated usually with from 10 to 12 pounds per cubic foot of oil. Engineers then went to the opposite extreme, until it was the general practice to inject 20, and in some cases even 24, pounds per cubic foot, resulting in a greatly increased cost and excessive bleeding of the oil. Recently the tendency has been to reduce absorption, and at present 16 pounds per cubic foot is about the average used.

The method of treatment first used was, in general, to subject the blocks to a dry heat of 250-280° F., or to steam them at pressures varying from 25 to 50 pounds per square inch for periods varying from 3 to 4 hours, or more, depending upon the condition of the wood. A vacuum of 24 to 26 inches was then drawn to remove the moisture, after which the preservative was admitted without breaking the vacuum, and pressure applied until the desired absorption was obtained.

At present the method of treating the blocks is often left to the treating plant operators, the specifications merely requiring a given absorption. Some cities, however, outline the method of treatment in detail as to preliminary steaming, vacuum, and pressure periods, giving the time, temperature, pressure, etc., for each operation.

Methods of Laying.

The old type of untreated block was generally laid either on a sand or a plank foundation, neither of which was satisfactory. Treated blocks were usually laid on a concrete foundation covered with a sand cushion, a method of laying which is still in quite general use. Much trouble has been experienced from the sand shifting or being washed from under the blocks, and thus producing an uneven surface in the pavement. Expansion troubles were also caused by water penetrating the spaces between the blocks and saturating the sand. A bituminous coating is now sometimes laid directly on the concrete base instead of the sand cushion.

While the sand cushion is still quite generally employed, there is a well marked tendency toward the use of a sand and cement mortar. This usually consists of a mixture of one part cement to three or four parts of sand and is spread from ½ to 1 inch thick. This results in a more satisfactory pavement, especially under heavy traffic.

The foundation now generally adopted consists of a concrete base from 5 to 7 inches deep, depending upon traffic conditions, the mixtures commonly used being 1, 3, 5, or 1, 3, 6.

Joints.

In some of the early pavements laid no expansion joints were used, and in many cases no trouble has been experienced on account of swelling. In many other cases, however, much trouble has been caused through failure to properly provide for swelling of the blocks.

Streets on which the traffic is heavy do not require as much provision for expansion as do streets of medium or light traffic. In the Brooklyn and Manhattan pavements no provision is made for expansion. For a street 30 or 40 feet wide the expansion joints are usually ¾ to 1 inch wide and filled with a bituminous filler. In most cities no joints are employed to take care of expansion lengthwise with the street.

The angle of courses is a point upon which engineers are not agreed. The most common method of laying has been at 90° with the curb, but many of the streets are now paved with the courses at an oblique angle. In the Minneapolis experimental pavement the blocks laid at oblique angle did not wear as fast as those laid at 90°, since traffic was not directly across the joints of the pavement. Another advantage of the oblique angle of laying is that longitudinal expansion joints at the curb will take care of expansion in both transverse and longitudinal directions.

Filler and Top Dressing.

A bituminous or pitch filler was commonly used in the early treated wood block pavements. Bituminous or asphaltic fillers and also sand and cement fillers are the materials generally used at the present time for filling the joints. The advocates of the sand filler maintain that the sand fills the joints completely and that the surface of the pavement becomes practically homogeneous. It is claimed that a waterproof joint is formd by the sand absorbing the oil which exudes from the blocks. Others argue that the sand packs into the joints, thereby making an unyielding filler which does not allow expansion, but permits water to enter between the blocks, causing expansion of the pavement.

Advocates of the cement grout filler claim that the use of this material insures the joints being completely filled and waterproof. The mixture is usually made of one part cement and one or two parts sand, which, after mixing to the proper consistency, is swept into the joints.

Opponents of the cement grout filler claim that unless the pavement is kept free from traffic for a sufficient time to allow the grout to set thoroughly the bond of the mortar will be broken. Even when the mortar is thoroughly set it is claimed that its strength is not sufficient for traffic conditions, and the filler, therefore, serves the purpose no better than sand, while at the same time it is more expensive.

Those favoring the bituminous filler argue that the joints filled with a tar or asphaltic preparation constitute individual expansion joints between each block, thereby allowing for expansion throughout the pavement. Moreover, it is claimed that the pavement is made waterproof and that no moisture can enter between or under the blocks.

On the other hand, advocates of the other fillers argue that a bituminous material becomes soft and sticky from the oils that exude from the blocks and may add to the bleeding trouble. In practice, the bituminous fillers are most largely used and are giving the best satisfaction.

The top dressing most commonly employed is a layer of sand spread about one-half inch deep over the completed pavement. This sand fills up any small pockets that may be present and is more or less ground into the wood, making the pavement less slippery.

Pavement Qualities.

In the selection of any pavement the following qualities should be considered:

1. First cost.
2. Durability.
3. Ease of maintenance.
4. Ease of cleaning.
5. Low tractive resistance.
6. Freedom from slipperiness.
7. Favorableness to travel.
8. Acceptability.
9. Sanitary qualities.

First Cost.

The first cost of treated wood block pavement is undoubtedly higher than that of most of the other paving materials. This cost averages from $2.25 to $3.75 per square yard, depending to a large extent upon the locality, species of wood used, method of treatment, amount laid, thickness of foundation, and various other factors.

The most economical pavement is that which will show the lowest average cost per year during its period of life. For this reason a pavement having a relatively high first cost may, on account of its greater durability and low maintenance cost, prove ultimately cheaper than one lower in first cost.

Durability.

Since most of the treated wood block pavements in this country have been laid within the last fifteen years, durability data are not as complete as on most of the other types of pavements. However, the condition of some of the early pavements laid gives an indication of

the durability of treated wood blocks as compared with other paving materials.

A number of examples of the condition of these pavements after several years' service have been given by various engineers. The pavement on Tremont Street, Boston, is in fair condition after fourteen years of service. The same is said of the first pavement laid in the Borough of Brooklyn, N. Y., in 1902.

In the Borough of Manhattan there are three streets which were laid in 1904, one of light traffic, one of medium traffic and one of heavy traffic. Eight years after laying, and three years after they had been out of guarantee, the heavy traffic street had cost 7 cents per square yard per year for repairs, and the average for all had been 6 cents per square yard per year. It was stated that only on the heavy traffic street had the repairs been due to wear and tear, while repairs on the other streets had been due to settlement over trenches, damage from fire, and other causes.

A treated wood pavement has been in use on Tenth Street, Minneapolis, for eleven years and is still in good condition.

In St. Louis in 1909 repairs to 50,000 square yards which were laid in 1903 cost a total of $2.10, and in 1911 repairs to the same 50,000 square yards cost less than 2/10 cent per square yard, so that the entire cost for repairs on the 50,000 square yards during the first nine years they were laid was only 2/10 cent per square yard. These blocks are laid on light traffic streets.

The pavements laid in Indianapolis during 1898, 1899, and 1900 are reported in bad condition, after 14 to 17 years' service.

Washington Street, Boston, was laid in 1906 and is in bad condition, this, however, being attributed to the use of over-seasoned gum.

Of the more recently laid pavements that have failed, the cause of failure could usually be traced to the use of improperly selected wood, poor treatment, or improper laying. Wood block in Chicago has given much trouble where it joins with street car tracks, but the use of a cement and sand cushion instead of a sand cushion has helped the situation.

When the best methods of treatment, combined with proper selection of materials and methods of laying, are adopted, a life of at least 15 years seem assured.

Ease of Maintenance.

This is a most important quality in any pavement. Frequent repairs are not only costly, but a great inconvenience to traffic. One of the features that recommends treated wood blocks is the low cost for maintenance and the ease with which repairs are made when necessary.

The cities that have had treated wood block pavements in use for ten or twelve years have found the maintenance cost to be below that of many of the other paving materials. In some cases practically no expenditure has been made for upkeep. When repairs are necessary the blocks are easily removed and no special equipment is required.

Ease of Cleaning.

Wood pavement is easy to clean as the surface is smooth, with no irregularities to collect dust and dirt. In addition, whatever material gathers on the surface must come from outside sources, as the pavement does not grind up and disintegrate as do many other materials. Engineers consider this one of the most easily cleaned pavements in use.

The pressure street flushing machines which many paving men object to, apparently have no bad effect upon wood blocks, and therefore a nightly scouring of the street is practicable.

Low Tractive Resistance.

Wood furnishes a low tractive resistance and in this respect it is probably the equal of any of the other types used.

Freedom from Slipperiness.

One of the main criticisms made of treated wood pavements is that it is slippery, and this trouble has prevented its wide use in some cities. On this account a number of engineers advocate the use of some other material on grades of more than three or four per cent. The slipperiness of a pavement is dependent also upon climatic conditions. If covered with a light frost or snow or the weather is foggy and damp, a wood block pavement may become objectionably slippery. In dry weather little trouble is experienced from this cause. A thin coating of sand spread over the surface has been found to be very useful in reducing slipperiness. The use of coarse salt has also been suggested as a remedy for this condition.

Favorableness to Travel and Acceptability.

Under favorableness to travel and acceptability are considered such factors as smoothness, freedom from dust, noiselessness, radiation and reflection of heat, and similar qualities.

The noiselessness of wood blocks as compared with other paving materials is a most valuable feature and one that has much to do with its popularity. In the large cities especially the noise caused by heavy traffic is very objectionable in the business districts. Wood blocks have, therefore, been particularly desirable in these sections.

The dark color of the blocks prevents glare or the reflection of light from the pavement, which is a minor disadvantage of some pavements.

Besides slipperiness and high first cost, bleeding and expansion troubles are the most objectionable features of treated wood blocks.

Bleeding of the blocks has been attributed to a variety of causes such as preservative or wood used, amount of oil injected, external pressure forcing the oil out of the blocks, expansion of the oil in the wood cells, expansion of air in the blocks which forces out the oil, capillary action, etc.

The Forest Products Laboratory has made a series of experiments for the purpose of determining the cause of bleeding and methods of preventing it. Results of these tests were discussed in a paper presented by Mr. C. H. Teesdale at the eleventh annual meeting of the American Wood Preservers' Association in 1915.

Expansion and heaving of wood pavement have given considerable trouble in some cities, especially on light traffic streets. Trouble from this source may be due to a variety of causes. Among these are the use of improper expansion joints, improper treatment of the blocks, and failure of the preservative to thoroughly penetrate the wood, or the use of a filler which is not adapted to the conditions. Various other causes may be responsible, depending upon the locality in which the pavement is laid.

Even when special care has been exercised to provide against expansion, bulging of the pavement has sometimes taken place. On the other hand, some cities have made no provision for expansion and have experienced but little, if any, trouble from this source. However, in most cases when expansion or bulging has taken place the difficulty can usually be traced to inadequate provisions for expansion, improper construction of the pavement, to the improper treatment of the blocks, or to the use of blocks which have dried out before being laid in the street. It seems likely that this trouble can be largely eliminated by treating the blocks in the green condition, and then taking precautions to prevent drying out before they are laid in the street. Special care should then be taken in the selection and application of the filler to insure a water-tight surface.

Sanitary Quality.

The modern treated wood block pavement is admitted to be fully as sanitary as any of the other pavements in use. On account of the smooth surface and well filled joints, dirt cannot collect in pockets and whatever is on the surface is easily removed.

Data and Literature.

In order to secure complete and up-to-date information on treated wood block pavements throughout the country, letters were sent to the engineers in practically all of the larger cities using wood blocks as a

paving material. A large number of these cities sent the information requested, from which most of the tabulated data in this report have been compiled. The Committee desires to express its thanks to the City Engineers who contributed this information, much of which represented considerable trouble to them. A portion of the data was furnished by members of the Committee from their files.

At the conclusion of this report is given a bibliography of some of the more important literature relating to the subject of wood pavements.

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American Lumberman	June	7,	1913.

The data in the following table were furnished on request by city engineers. It is not entirely complete, as only the larger cities were written to, and some of them did not reply.

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Birmingham, Ala......	1906	6,138	Longleaf Pine	Poor	Light Travel.
	1906	2,700	" "	Fairly Good	4" Concrete Base—on viaduct.
	1913	36,882	" "	Good	5" Concrete Base.
	1914	16,000*	" "		
	Total	61,720			
Mobile, Ala............	1904	13,023		Good	4" Block. Sand Filler.
	1906	11,158	Longleaf Pine	Fair	3" " " "
	1908	34,910	" "	"	3" " " "
	1909	88,628	" "	Excellent	3" " " "
	1910	27,997	" "	Fair	3" " " "
	1911	33,606	" "	Excellent	3" " " "
	1912	28,693	" "	"	3" Block. Bituminous Filler.
	1913	18,650	" "	"	3" " " "
					90% heart.
	Total	256,665			
Pine Bluff, Ark.......	1910	26,000	Longleaf Pine	Bad	1910 Pavement Buckles Badly.
	1911	6,000	" "	Fair	
	1913	35,000	" "	Very Good	
	Total	67,000			
Fort Smith, Ark......	1912	32,000	Longleaf Pine	Good	Heavy Traffic St. 16 lb. abs. per cu. ft.

*About this amount. Figures furnished by block manufacturers.

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Bridgeport, Conn......	1907	13,695	Longleaf Pine	Good	Treatments varied from 12 to 20 lbs. abs. per cu. ft.
	1908	873	" "	"	Now is 16 lb.
	1910	31,560	" "	"	
	1911	50,865	" "	"	
	1912	5,000	" "	"	3" and 3½" blocks used.
	1913	71,761			
	Total	173,754			
New Britain, Conn....	1913	7,675	Southern Yellow Pine	Fairly Good	
New Haven, Conn.....	1908	17,059	Longleaf Pine	First Class	
	1909	994	" "	" "	
	1910	11,483	" "	" "	3½" blocks used.
	1911	14,090	" "	" "	
	1913	46,753	Shortleaf and Longleaf Yellow Pine	" "	
	1914	75,961	Longleaf Pine	" "	
	Total	166,340			
Ansonia, Conn........	1910	380	Yellow Pine	Good	
	1914	10,000	Longleaf Pine	"	
	Total	10,380			
Miami, Fla...........	1914	22,982	Longleaf Pine	Good	3½" blocks.

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Pensacola, Fla........	1909	40,000	Longleaf Pine	Excellent	
	1911	85,000		"	
	Total	125,000			
Albany, Ga..........	1912	8,250	Longleaf Pine	Good	20-lb. per cu, ft. treatment. Some trouble with buckling after dry spells. 3" blocks—5" concrete. ½" sand cushion and filled joints.
Americus, Ga.........	1911-12	36,353	Longleaf Yellow Pine	"	20 lbs. creosote oil per cu. ft.
Athens, Ga...........	1908	3,500*	Longleaf Pine	"	3½" blocks.
Augusta, Ga..........	1912-13	9,000*		Excellent	3" blocks. Pitch filler.
Macon, Ga............	1910	12,500	Longleaf Pine	Good	3" blocks.
Newnan, Ga..........	1911	13,500	" "	"	3" blocks.
Rome, Ga.............	1911	8,200	" "	"	Experience shows that heavy traffic is necessary to keep pavement in condition, otherwise trouble with swelling and buckling.
	1911-12	7,800		"	
	1911-12	14,350		Fair	
	Total	30,350			

*About this amount. Figures furnished by block manufacturers.

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Atlanta, Ga.	1908	40,480	Longleaf Pine	One street bad, others good.	
	1910	53,999			
	1911	9,334			
	1912	12,468			
	1913	6,042			
	Total	122,323			
Chicago, Ill.	1904		Longleaf Pine	Fair	
	1905	3,119	" "	"	
	1906	13,520	" "	"	
	1907	12,072	Longleaf Pine, Tamarack and Black Gum Norway Pine	"	
	1908	87,162	Longleaf Pine, Tamarack and Black Gum	Good	
	1909	67,342	Longleaf Pine, Tamarack and Black Gum	"	
	1910	63,857	Longleaf Pine, Tamarack and Black Gum	"	
	1911	237,912	Longleaf Pine, Tamarack and Black Gum	"	
	1912	115,782	Longleaf Pine and Tamarack	"	
	1913	165,536	Longleaf Pine and Tamarack	"	
	Total	766,302			
Granite City, Ill.	1912	10,081	Longleaf Pine	Good	Considered best pavement constructed.
	1913	11,049	" "	"	
	Total	21,130			

CITY.	Laid. Year	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
E. St. Louis, Ill.......	1910	14,838	Southern Yellow Pine	Good	3" block on 1" sand cushion and 5" of 114.7 concrete.
Peoria, Ill.............	1911	16,835	Longleaf Pine	Very Good	Appears to surpass all other types of pavement.
	1912	4,338	" "	"	
	1913	10,199	" "	"	
	Total	31,372			
Muncie, Ind...........	1913	15,896	Longleaf Pine	Good	
Indianapolis, Ind......	1898	60,439	" "	Bad	
	1899	7,863	" "	"	
	1900	19,916	" "	"	
	1901	35,774	" "	Fair	
	1902	7,769	Washington Cedar	"	
	1903	8,678	Longleaf Pine	"	
	1904	24,612	" "	"	
	1906	13,112	" "	Good	
	1907	10,049	" "	"	
	1908	36,542	" "	"	
	1909	8,662	" "	"	
	1910	5,195	" "	"	
	1911	2,040	" "	"	
	1913	19,227	" "	"	
	Total	259,8/8			
Cedar Rapids, Iowa....	1911	7,356	Longleaf Yellow Pine	Good	
	1913	5,675	" " "	"	
	1914	5,921	" " "	"	
	Total	18,952			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Des Moines, Iowa.....	1910	48,677.5	Longleaf Pine		
	1910	16,153.1	" "		
	1911	8,581	" "		
	1912	3,961.7	" "		
	1913				
	Total	77,373.3			
Clinton, Iowa.........	1909	4,572		Good	3" block treated with 20-lb. abs.
	1910	8,310		"	
	Total	12,882			
Fort Dodge, Iowa.....	1909	12,500	Longleaf Pine	First Class	Blocks laid in 1912 were placed on viaduct floor.
	1912	4,000	" "	"	
	Total	16,500			
Indianola, Iowa.......	1909	12,200	Longleaf Pine	First Class	Tar filler. 16-lb. cu. ft. impreg., no bleeding, covered with limestone dust on top of hot tar filler, slight bulge in winter, 1½" fine sand cushion.
Mason City, Iowa.....	1908	7,300	Northern Yellow Pine	"	
	1911	360	" " "	"	
Ottumwa, Iowa.......	1910	1,150	Longleaf Pine	Good	Abs., 16-lb. per cu. ft. 1912, blocks laid on bridge and approaches.
	1912	2,900	" "	"	
Perry, Iowa...........	1910	33,000	" "	Excellent	

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Sioux City, Iowa......	1906	16,120	Norway Pine	Relaid 1913	Experience with wood blocks has not been entirely successful, possibly due to improper methods of laying.
	1908	850	" "	Fair	
	1909	4,860	" "	"	
	Total	21,830			
Hutchinson, Kan......	1911	3,000	Longleaf Pine	Good	Blocks show no wear, 3" deep treated with 16-lb. abs. per cu. ft.
	1912	2,000	" "	"	
	1913	300	" "	"	
	Total	5,300			
Wichita, Kan..........	1910	1,577.6	Longleaf Pine	Excellent	
	1911	636.87	" "	"	
	1912	1,510.85	" "	"	
	1913	1,300.00	" "	"	
	1914	325.00	" "	"	
	Total	5,350.32			
Lexington, Ky........	1913	454.64	Longleaf Pine	Good	
Newport, Ky..........	1904	8,000	Southern Yellow Pine	Excellent	Somewhat slippery during rainy weather.
	1907	4,000	" " "	"	
	Total	12,000			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Louisville, Ky.........	1910	7,351.8	Longleaf Pine	Good	
	1912	4,756.9	" "	"	
	1913	4,937.6	" "	"	
	Total	17,046.3			
Shreveport, La........	1910	1,750	Yellow Pine	Good	Blocks laid in 1912 were laid on very steep grade and caused trouble from buckling and water getting under blocks.
	1912	18,442	" "	Fair	
	1913	6,400	" "	Good	
	Total	26,592			
Crowley, La...........	1912	20,000*		Excellent	3" blocks. Sand filler.
New Orleans, La......	1911	4,779.30	Longleaf Pine	Good	Laid by city.
	1912	6,001.70	" "	"	" " "
	1913	8,817.70	" "	"	" " "
	1914	2,115.87	" "	"	" " "
	1911-14	41,270.00	" "	"	Laid in street car tracks.
	1911-14	13,000.00	" "	"	Laid by Port Commission.
	1911-14	14,886.00	" "	"	Laid by Port Facilities and Trans-Mississippi Terminal Co.
	Total	90,870.57			
Opelousa, La..........	1913	13,482	Longleaf Southern Pine	Good	Trouble the first month with excessive tar. Now in first-class condition.
Baltimore, Md...... ..	Up to 1913	34,733	Longleaf Pine	"	Not satisfactory because of slipperiness.

*About this amount. Figures furnished by block manufacturers.

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Boston, Mass..........	1900	1,295	Longleaf Pine	Excellent	
	1901	11,684	" "	Very Good	
	1903	2,859	" "	"	
	1906	10,704	Longleaf Pine and Black Gum	Good	
	1907	7,836	Black Gum	Fair	
	1908	4,670	Longleaf Pine and Black Gum	Very Good	
	1909	6,012	Longleaf Pine	Excellent	
	1910	3,196	" "	"	
	1911	17,464	" "	"	
	1912	44,192	" "	"	
	1913	48,312	" "	"	
	Total	158,224			
Cambridge, Mass......	1912	26,548	Longleaf Pine	Excellent	
	1913	9,840	" "		
	Total	36,388			
Springfield, Mass......	1903	5,652	Longleaf Pine	Fair	Rough in spots.
	1904	11,981	" "	"	" " "
	1906	6,460	" "	"	" " "
	1907	4,590	" "	Good	
	1908	5,624	Black Gum	"	
	1909	12,421	" "	"	
	1910	6.153	Longleaf Pine	"	
	1911	6,722	" "	"	
	1912	12.515	" "	"	

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Louisville, Ky.........	1910	7,351.8	Longleaf Pine	Good	
	1912	4,756.9	" "	"	
	1913	4,937.6	" "	"	
	Total	17,046.3			
Shreveport, La........	1910	1,750	Yellow Pine	Good	Blocks laid in 1912 were laid on very steep grade and caused trouble from buckling and water getting under blocks.
	1912	18,442	" "	Fair	
	1913	6,400	" "	Good	
	Total	26,592			
Crowley, La...........	1912	20,000*		Excellent	3" blocks. Sand filler.
New Orleans, La......	1911	4,779.30	Longleaf Pine	Good	Laid by city.
	1912	6,001.70	" "	"	" " "
	1913	8,817.70	" "	"	" " "
	1914	2,115.87	" "	"	" " "
	1911-14	41,270.00	" "	"	Laid in street car tracks.
	1911-14	13,000.00	" "	"	Laid by Port Commission.
	1911-14	14,886.00	" "	"	Laid by Port Facilities and Trans-Mississippi Terminal Co.
	Total	90,870.57			
Opelousa, La..........	1913	13,482	Longleaf Southern Pine	Good	Trouble the first month with excessive tar. Now in first-class condition.
Baltimore, Md.......	Up to 1913	34,733	Longleaf Pine	"	Not satisfactory because of slipperiness.

*About this amount. Figures furnished by block manufacturers.

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Boston, Mass..........	1900	1,295	Longleaf Pine	Excellent	
	1901	11,684	" "	Very Good	
	1903	2,859	" "	"	
	1906	10,704	Longleaf Pine and Black Gum	Good	
	1907	7,836	Black Gum	Fair	
	1908	4,670	Longleaf Pine and Black Gum	Very Good	
	1909	6,012	Longleaf Pine	Excellent	
	1910	3,196	" "	"	
	1911	17,464	" "	"	
	1912	44,192	" "	"	
	1913	48,312	" "	"	
	Total	158,224			
Cambridge, Mass......	1912	26,548	Longleaf Pine	Excellent	
	1913	9,840	" "		
	Total	36,388			
Springfield, Mass......	1903	5,652	Longleaf Pine	Fair	Rough in spots.
	1904	11,981	" "	"	" " "
	1906	6,460	" "	"	" " "
	1907	4,590	" "	Good	
	1908	5,624	Black Gum	"	
	1909	12,421	" "	"	
	1910	6.153	Longleaf Pine	"	
	1911	6,722	" "	"	
	1912	12,515	" "	"	

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Springfield, Mass. (Con.)............	1913	26,899	Longleaf Pine	Good	
	Total	99,017			
Detroit, Mich..........	1906	6,761	Longleaf Pine	Good	
	1907	24,951	" "	"	
	1908	34,990	" "	"	
	1909	15,971	" "	"	
	1910	26,148	" "	"	
	1911	48,111	" "	"	
	1912	168,040	" "	"	
	1913	166,623	" "	"	
	Total	458,686			
Houghton, Mich......	1905	13,000	Norway Pine and Tamarack	Good	
Minneapolis, Minn....	1902	13,616	Longleaf Pine	Excellent	
	1903	30,825	Longleaf, Norway Pine, Tamarack and Hemlock	Longleaf Excellent; other species fair	
	1904	59,186	" " "		
	1905	44,838	" " "		The City does its own work by day labor.
	1906	75,727	" " "	"	Nearly 1,400 sq. yds. of the pavement laid in 1906 were in the experimental section. The species used in this section were longleaf pine, Norway pine, Tamarack, Hemlock, White Birch and Douglas fir.
	1907	103,505	Norway Pine, Tamarack and Hemlock	"	
	1908	166,768	" "	Good	
	1909	143,339	Longleaf Pine, Norway Pine, Tamarack and Hemlock.	Longleaf in excellent condition	

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Minneapolis, Minn. (Con.)	1910	156,550	Longleaf Pine, Norway Pine, Tamarack and Hemlock		The fir section was replaced in 1911.
	1911	123,861	" "		
	1912	129,962	Longleaf Pine		
	1913	136,644	" "		
	Total	1,184,821			
Duluth, Minn.	1905	15,940.7	Tamarack	Good	
	1912	9,568.1	"	"	
	1913	10,288.7	"	"	
	Total	35,737.5			
Rochester, Minn.	1911	30,437	Tamarack and Norway Pine	Excellent	
	1912	18,038	" "	"	
	1913	4,564	" "	"	Amount for 1914 under construction.
	1914	16,756	" "	"	
	Total	69.795			
Winona, Minn.	1913	5,789.30	Tamarack	Fine	
Jackson. Miss.	1910	5,118	Longleaf Yellow Pine Used Exclusively	Good	3" block, sand filler, 5" concrete 1:3:6.
	1912	17,634		"	
	Total	22,752			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Greenwood, Miss......	1913	23,000*		Excellent	3″ block. Pitch filler.
Meridian, Miss........	1911	20,000	Longleaf Pine	Fair Blocks start to bulge after each rainy spell	3″ block, sand filler.
Laurel, Miss..........	1913 1914	21,000 7,800	Longleaf Yellow Pine " " "	Perfect "	16 lbs. per cu. ft. 20 " " " "
	Total	28,800			
Vicksburg, Miss.......	1914	8,000	Contract let by V. and M. V. Ry.		
Chisholm, Minn........	1912 1913	11,000 27,000	Tamarack "	Good "	
	Total	38,000			
St. Paul, Minn........	1912 1913 1914	10,574.3 96,759.2 26,663.3	Longleaf Pine	First Class	1914 amount is under construction.
	Total	373,966.5			
Austin, Minn..........	1906 1913	1,173.00 43,687.75	Tamarack Tamarack and Norway Pine	Good Excellent	Work in 1906 was laid with sand filler. Paving pitch filler used in all other work.

*About this amount. Figures furnished by block manufacturers.

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Austin, Minn. (Con.)	1914	5,054	Tamarack	Excellent	
	Total	49,864.75			
Red Wing, Minn.	1910	About 5,000	Tamarack	Perfect	3" blocks used.
	1914	6,730	"		
	Total	11,730			
Albert Leg, Minn.	1909	28,046	Tamarack and Norway Pine	Good	
	1910	22,795	" "	"	
	1911	32,703		"	
	Total	83,544			
Faribault, Minn.	1910	528.82	Tamarack	Excellent	
	1912	15,945.90	"	"	
	Total	16,474.72			
Owatonna, Minn.	1912	29,184	Norway Pine and Tamarack	Excellent	3½" blocks.
	1914	10,000			3" blocks. Do not like sand cushion.
	Total	39,184			
Kansas City, Mo.	1906	6,860	Longleaf Pine	Fair	1909 pavement has sound service, cuts poorly repaired, otherwise excellent.
	1909	390	" "	Good	
	1910	6,656	" "	Excellent	
	1911	18,887	" "	"	

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Kansas City, Mo. (Con.)	1912	1,021	Longleaf Pine	Excellent	
	1913	2,191	" "	"	
	1914	25,614	" "	"	
	Total	61,619			
Joplin, Mo............	1909	2,888	Longleaf Pine	Good	The 1909 blocks were placed on steel viaduct; 1911 blocks on old base. The surface of the 1913 blocks is rough.
	1911	22,548	" "	Excellent	
	1913	770	" "	Fair	
	1914	1,551	" "		
	Total	27,757			
Cape Girardeau, Mo...	1909	7,309	Longleaf Pine	Good	1912 work done by St. L. & S. F. R. R. Some trouble from expansion between street-car tracks.
	1910	7,046	" "	"	
	1912	3,000	" "	"	
	Total	17,455			
St. Joseph, Mo.......	1909		Longleaf Pine	Good	Small viaduct 430 ft. long. Car Co. used wood blocks between tracks.
St. Louis, Mo.........	1903	49,614	" "	"	3½" x 4"—6" to 10" long. Blocks of 1903 with 12 lb. cu. ft. showing decay at center in 11th year. Trouble along car tracks as sand cushion gets chance to move under blocks.
	1908	5,772	" "	"	
	1909	11,115	" "	"	
	1910	55,163	" "	"	
	1911	77,819	" "	"	
	1912	130,940	" "	"	
	1913	21,520	" "	"	

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
St. Louis, Mo. (Con.)..	1914	87,666	Longleaf Pine	Good	
	Total	439,609			
Billings, Mont.........	1910	36,766.2	E Tamarack	Good	1910 pavement gives some trouble from heaving and slipperiness; otherwise O. K.
	1913	23,427.6	W "	"	
	1914	5,282.5	W "	"	
	Total	65,476.3			
Missoula, Mont.......	1912	5,808.49	Tamarack	First Class	Five year guarantee.
Jersey City, N. J.....	1908	5,257.9	Longleaf Pine	Fair	10 year guarantee.
	1909	8,194.0	" "	"	5 " "
	1909	20,590.5	" "	"	10 " "
	1910	4,686.8	" "	"	5 " "
	1911	8,628.0	" "	Good	5 " "
	1912	4,026.7	" "	"	5 " "
	1913	2,636.9	" "	"	5 " "
	1914	3,460.0	" "	"	5 " "
	Total	57,480.8			
Newark, N. J.........	1909	4,518	Longleaf Pine	Excellent	1914 amount being laid.
	1914	75,500	" "		
	Total	80,018			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
New York, N. Y.— Borough of Manhattan	1902	1,152	Longleaf Pine	Very good	
	1903	13,555	" "	"	
	1904	20,902	Longleaf Yellow Pine		Streets show very little wear and tear except alongside of rail and over old trenches.
	1905	49,251	" " "		
	1906	92,808	" " "		
	1907	-11,971	" " "		
	1908	35,968	Black Gum		
	1909	16,352	" "		
	1910	82,063	" "		
	1911	78,690	Longleaf Yellow Pine		
	1912	143,465	" " "		
	1913	77,229	" " "		
	Total	608,699			
Borough of Bronx..	1904	8,101.6	Yellow Pine	Fair to poor	
	1906	321.0	" "	Good	
	1907	5,170.6	" "	"	
	1908	18,381.9	" "	"	
	1908	60,857.9	Black Gum	"	
	1911	5,987.2	Yellow Pine	"	
	1912	7,868.5	" "	"	
	1913	15,102.7	" "	"	
	Total	121,789.4			
Borough of Brooklyn	1904	20,016	Yellow Pine	Very good	
	1905	4,200	" "	" "	
	1910	1,991	" "	" "	

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Borough of Brooklyn (Con.)............	1911	15,399	Yellow Pine	Very Good	1912 Pavement very good except Broadway, on which a section is badly worn.
	1912	59,100	" "	" "	
	1913	16,161	" "	" "	
	Total	131,574			
Borough of Queens....	1904	1,230	Longleaf Yellow Pine		Repaved granite.
	1905	60,626	" " "	Good	
	1906		" " "		
	1907	22,147	" " "	"	
	1908	8,332	" " "	"	
	1909	8,235	" " "	"	
	1910	3,485	" " "	"	
	1911		" " "		
	1912	19,070	" " "	"	
	1913	46,761	" " "	"	
	Total	169,886			
Borough of Richmond..	1905	3,471	Longleaf Yellow Pine	Good	
	1909	6,119	" " "	"	
	1910	12,957	" " "	"	
	1911	12,514	" " "	"	
	1912	19,888	" " "	"	
	1913	48,583	" " "	"	
	1913	20,550	So. Longleaf Yellow Pine	"	
	Total	124,082			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Geneva, N. Y........	1900	1,606	Yellow Pine	Very Good	Trouble from expansion.
Jamestown, N. Y.....	1903	About 1,500	Longleaf Pine	Good	Some trouble on account of slipperiness and expansion. No provision was made for expansion.
Poughkeepsie, N. Y...	1909	4,350	" "	Excellent	Slippery, due to too much crown.
	1911	1,500	" "		
	Total	5,850			
Binghamton, N. Y.....	1912	1,453	Longleaf Pine	Good	Blocks laid on bridge floors.
	1913	1,209	" "	"	
	1914	1,586	" "		
	Total	4,248			
Elmira, N. Y..........					No wood block pavement.
Albany, N. Y..........	1913	8,000	Commercial Yellow Pine	Good	
Peekskill, N. Y........	1913	20,000	Shortleaf Pine	Very Good	5" concrete, ½" cushion.
Schenectady, N. Y.....	1913	3,425	Longleaf Pine	O. K.	
Watertown, N. Y.....	1911	6,000	" "	Good	Pavement laid in 1913 gives trouble from heaving and bleeding.
	1913	7,500	Shortleaf N. C. Pine	"	
	Total	13,500			

CITY.	Year Laid	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Utica, N. Y..........	1911			Good	On a viaduct.
Oswego, N. Y........	1907	1,300	Longleaf Pine	Fair	Considerable heaving of blocks.
	1911	2,100	" "	"	
	Total	3,400			
Fargo, N. D..........	1911	13,980	Yellow Pine	Good	Bridge floors.
	1911	1,877	" "	"	" "
	1912	850	" "	"	" "
	1912	1,388	" "	"	" "
	1913	923	" "	"	Street.
	Total	19,018			
Grand Forks, N. D....	1908	49,550	White Pine and Norway Pine	Good	20-lb. abs.' per cu. ft.
	1909	9,521			
	1910	521			
	Total	59,592			
Cincinnati, Ohio......	1908	76,908	Longleaf Pine	Good	
	1909	19,259	" "	"	
	1910	49,045	" "	"	
	1911	94,872	" "	"	
	1912	7,653.6	" "	"	
	1913	4,332	" "	"	
	Total	252,069.6			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Cleveland, Ohio.......	1911	2,671	Longleaf Pine	Very good	
	1912	12,200	” ”	” ”	
	1913	4,943	” ”	” ”	
	Total	19,814			
Dayton, Ohio.........	1913	5,500		Good	1914 Pavement under construction.
	1914	16,400			
	Total	21,900			
Norwood, Ohio.......	1913	6,000	Longleaf Pine	Good	Trouble from expansion.
	1914	10,000		”	
	Total	16,000			
Akron, Ohio..........	1913	29,450	Longleaf Southern Pine	Good	6″ concrete base 3½″—16 lb. cu. ft. blocks.
	1913	7,150	” ” ”	”	6″ concrete base 3″—12 lb. cu. ft. blocks.
	Total	36,600			Tar filler with 1½″ expansion strips at curbs.
Youngstown, Ohio....	1901	2,900	Yellow Pine	Good	Bridge floor.
	1911	15,827	” ”	”	” ”
	1912	850	” ”	”	” ”
	1912	1,388	” ”	”	Street Paving.
	1913	923	” ”	”	” ”
					Have had trouble from bleeding.
	Total	21,888			

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Delaware, Ohio........	1909	8,000	Yellow Pine	Good	No repairs to date.
	1911	7,000	" "	"	
	Total	15,000			
Toledo, Ohio..........	1902	6,601	Longleaf Pine	Good	Streets are all in good condition, except one, which is the fault of the foundation.
	1904	47,235	" "	"	Very little maintenance cost.
	1905	78,737	" "	"	Main trouble is from bleeding, which lasts from one to three seasons.
	1909	8,829	" "	"	Blocks show but little wear.
	1912	1,083	" "	"	
	1913	13,963	" "	"	
	Total	156,448			
Portland, Ore..........			Fir		About 1.67 miles of fir blocks were in place at end of 1913. No data as to date of laying cost, etc.
Philadelphia, Pa.......	1909-10	83,705	Longleaf Pine	Good	
	1912	63,351	" "	"	
	1913	39,792	" "	"	
	Total	186,848			
Harrisburg, Pa........	1904	3,006.2	Longleaf Pine	Good	Residence street, light traffic.
Easton, Pa...........	1909	4,683	" "	Excellent	Laid on old foundation.

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Pittsburgh, Pa........	1908	374	Longleaf Pine	Very Good	
	1910	4,000	" "	" "	
	1911	2,413	" "	" "	
	1912	9,910	" "	" "	
	1913	15,200	" "	" "	
	Total	31,897			
Steelton, Pa..........	1906	32,831	Yellow Pine	Good	Creo. resinate process laid by Traction Co. Trouble with expansion.
	1914	7,478			
	Total	40,309			
Reading, Pa..........	1913	4,911	Longleaf Pine	Good	4,727 sq. yds. of blocks laid in 1914, used in resurfacing.
	1914	13,394	" "	"	
	Total	18,305			
Providence, R. I......	1912	550.2	Longleaf Pine	Very Good	
	1913	25,083.7		" "	
	1914	3,643.0		" "	
	Total	29,276.9			
Charleston, S. C......	1912-13	9,855.70	Shortleaf Yellow Pine	Very Good	16 lbs. per cu. ft., 3" block, 4" concrete.
	1913	14,620.10	Longleaf Yellow Pine	" "	16 lbs. per cu. ft., 3" block, 4" concrete.
	1914	22,000.00	" " "	" "	16 lbs. per cu. ft., 3" block, 4" concrete.
	Total	46,475.80			

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Aberdeen, S. D.......	1907	31,125.10	Norway Pine and Tamarack	Rather Poor	All blocks are 3" with 16 lb. treatment. Poor condition, due to swelling and heaving.
	1908	14,336.00		" "	
	1909	42,600.00		" "	
	1910	20,546.50		" "	
	Total	108,607.60			
Memphis, Tenn.......	1911	21,190.5	Longleaf Pine	First Class	Blocks laid in 1911 were laid on old foundation.
	1912	53,222.9	" "	" "	Total laid by city 73,031.8; by St. R. R. 33,899.4; by city and St. R. R., 106,931.2.
	1913	32,517.8	" "	" "	
	Total	106,931.2			
Bristol, Tenn.........					Do not use Wood Block Pavement.
Austin, Texas........	1909	4,047	Yellow Pine.	Very Poor	Most of the wood-block pavement laid here has been unsatisfactory. Buckles badly in wet weather.
	1911	1,264	" "	Good	
	1912	10,160	" "	Very Poor	
	1913	10,716	" "	" "	
	1914	7,420	" "	Good	
	Total	33,607			
Beaumont, Texas.....	1911	11,805	Longleaf Pine	Good	90 per cent. heart.
	1912-13	42,041	" "	"	Square edged and sound.
	Total	53,846			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Waxahachie, Texas...	1912	3,100	Longleaf Pine	Excellent	3" Block.
	1913	4,050	" "	"	
	Total	7,150			
Corsicana, Texas.....	1913				*Several hundred yards laid in a St. Ry. area.
San Angelo, Texas....	1912	20,455	Longleaf Pine	Bad	Much trouble from buckling, due to improper treatment.
	1913	21,777	" "	"	
	Total	42,232			
Brownsville, Texas...	1912-13	35,000*		Good	3½" blocks
Dallas, Texas.........	1908-09	514.0	Yellow Pine	Good	Depth of blocks, 3", 3½" and 4".
	1910	376.5	" "	"	
	1911	31,159.68	" "	"	
	1912	57,909.30	" "	"	
	1913	64.499.61	" "	"	
	1914	73,173.16	" "	"	
	Total	227,632.25			
Greenville, Texas.....	1911	23,863	Longleaf Pine	Bad	Poor construction, due to poor St. Ry. construction and applies to 11,000 yds. only.
Ft. Worth, Texas.....	1913	17,996			
	1914	9,715	Longleaf Yellow Pine	Good	20 lb. per cu. ft. treatment.
			" " "	"	" " " " " "
	Total	27,711			

*About this amount. Figures furnished by block manufacturers.

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Houston, Texas.......	1910	9,000*	Longleaf Pine	Fair	3" block, sand filler.
	1911	9,000*	" "	Excellent	3" " " "
	1913	2,353	" "	Good	3" blocks.
	1914	65,783	" "		Yardage to September 1st, more being laid; ½—3½" blocks—½, 3" blocks. All asphalt filler.
	Total	86,136			
Nacogdoches, Texas..	1913	12,000*		Excellent	16 lb. Treatment. 3" block. Asphalt filler.
Longview, Texas......	1911	17,000	Southern Yellow Pine	Good	3" block, 1" sand filler. Trouble from swelling.
New Braunfels, Texas.	1913				*Several hundred yards laid on a bridge.
Taylor, Texas.........	1912	20,000*		Excellent	3½" blocks. Sand filler.
Paris, Tex............	1913	5,347	Longleaf Pine	"	Have had no trouble whatever.
San Antonio, Texas...	1912	360	So. Longleaf Yellow Pine		1" sand cushion.
	1913	14,803			
	1914	61,153			
	Total	76,316			
Wichita Falls, Texas..	1911-13	36,000	So. Longleaf Yellow Pine	Good	

*About this amount. Figures furnished by block manufacturers.

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Norfolk, Va..........	1908	875	Black Gum	Good	All pavements are in excellent condition with exception of two which are traversed by street-car tracks along whicl for about 12" on outside of rails the blocks have shown a tendency to pop out, due to faulty construction.
	1909	6,739	Black Gum and Pine	"	
	1910	27,667	" " " "	"	
	1911	13,856	Pine	"	
	1913	1,535	"	"	
	Total	50,672			
Petersburg, Va.......	1913	2,000	Yellow Pine	Good	
	1914	16,000	" "		25,000 sq. yds. to be laid 1914-15.
	1915	25,000		To be laid	
	Total	43,000			
Centralia, Wash.......	1913	3,000	Fir	Good	Blocks are cut from cull cross-arm material. Abs. 12-lb. cu. ft. Some blocks not fully penetrated.
Seattle, Wash.........	1897	1,144	Douglas Fir	Replaced	Blocks dipped in creosote and received poor penetration.
	1902	1,227	" "	Part Replaced	
	1903	1,989	" "	"	
	1911	960	" "	Good	Slippery.
	1913	518	" "	"	
	Total	5,838			
Spokane, Wash.......	1911	4,367	Red Fir	Fair	Treated with avenarious carbolineum. Trouble from swelling.
	1912	891	" "	Good	
	1913	6,051	Douglas Fir	"	
	1914	13,171	Larch	"	
	Total	24,480			

CITY.	Year Laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Tacoma, Wash.........	1913	6,624	Fir	Good	Laid on creosoted wood flooring on bridges.
Beloit, Wis............		200			On a bridge.
Eau Claire, Wis......	1913	2,000	Longleaf Pine	Excellent	Blocks laid on creosoted plank floor. 16-lb. abs. cu. ft.
Superior, Wis.........	1907	7,516	Norway Pine	Good	
	1910	9,223	Tamarack	"	
	1911	4,112	"	"	1911 blocks laid on bridges.
	Total	20,851			
Lake Geneva, Wis.....	1914	21,288	Longleaf Pine		Under construction.
Appleton, Wis.........	1909	34,173.31	Norway Pine	Good	
	1910		Tamarack	"	
	1911		Longleaf Pine	"	
Milwaukee, Wis......	1907	7,749		Fair	
	1909	10,008		Good	
	1910	30,149		"	
	1913	27,777.23		"	
	1914	5,673		"	
	Total	81,356.23			

AMOUNT, KIND AND CONDITION OF TREATED WOOD BLOCK PAVING IN VARIOUS CITIES OF THE UNITED STATES.—(Continued).

CITY.	Year laid.	No. of sq. yards laid each year.	Species of Timber used.	Condition at present.	REMARKS.
Watertown, Wis......					Has only a few bridge floors paved with Tamarack Blocks.
Madison, Wis.........	1910	9,376	Longleaf Pine	Good	
	1911	7,967	" "	"	
	Total	17,343			
Lacrosse, Wis..........	1906	1,925	Pine	Fair	
	1907	9,221	Tamarack	"	
	1912	881	"	Good	

DEPTH OF BLOCKS USED.

The following table shows the *depth of block used in several cities*. The data were furnished by a member of the committee.

City or Town.	State.	Depth.	Depth.	Depth.
Aberdeen	S. Dak.	3 in.	......	......
Akron	Ohio.	3 "	& 3½ in.	......
Albany	N. Y.	.....	3½ "	......
Albert Lea	Minn.	.....	......	4 in.
Allentown	Pa.	.....	3½ "	......
Appleton	Wis.	3 in	3½ "	......
Asbury Park	N. J.	3 in.	......	......
Atlantic City	N. J.	.....	3½ "	......
Austin	Minn.	3 "	& 3½ in.	......
Baltimore	Md.	3 "	*3½ "	......
Bangor	Maine.	.....	3½ "	......
Binghamton	N. Y.	.....	3½ "	4 in.
Boston	Mass.	.....	3½ "	*4 in.
Bridgeport	Conn.	3 "	*3½ "	......
Brooklyn	N. Y.	.....	......	4 in.
Charleston	S. C.	.....	3½ "	......
Charlotte	N. C.	.....	3½ "	4 in.
Chester	Pa.	3 in.	......	......
Chicago	Ill.	.....	......	4 in.
Chicopee Falls	Mass.	.....	3½ "	......
Chisholm	Minn.	3 in	3½ "	......
Cincinnati	Ohio.	.....	3½ "	......
Cleveland	Ohio.	.....	......	4 in.
Columbia	S. C.	3 in.	......	......
Columbus	Ohio.	.....	3½ "	......
Covington	Ky.	.....	3½ "	......
Dayton	Ohio.	3 in.	......	......
Decatur	Ill.	.....	3½ "	......
Des Moines	Iowa.	.....	3½ "	......
Detroit	Mich.	.....	3½ "	......
Duluth	Minn.	3 in.	3½ "	4 in.
Easton	Pa.	.....	......	4 in.
East Orange	N. J.	.....	......	4 in.
Faribault	Minn.	3 in.	......	......
Fitchburg	Mass.	.....	3½ "	......
Flint	Mich.	.....	3½ "	......
Grand Rapids	Mich.	3 in.	......	......
Greenville	S. C.	3 "	3½ "	4 in.
Greenwich	Conn.	.....	3½ "	......
Hamilton	Ont.	3 in.	......	......
Hazelton	Pa.	.....	......	......
Hibbing	Minn.	.....	3½ "	......
Highland Park	Mich.	.....	3½ "	......
Indianapolis	Ind.	.....	......	4 in.
Jamestown	N. Y.	.....	......	4 in.
Jersey City	N. J.	.....	3½ "	......

*Depth of block at present used.

DEPTH OF BLOCKS USED.—(Concluded)

City or Town.	State.	Depth.	Depth.	Depth.
Kansas City	Mo.	*3 in. now	......	4 in.
Key West	Fla.	3 in.	......	......
Knoxville	Iowa.	3 in.	......	......
Lancaster	Pa.	3 in.	......	......
Lawrence	Mass.	.....	3½ in.	......
Lebanon	Pa.	3 in.	......	......
Lincoln	Ill.	.....	3½ "	......
Louisville	Ky.	.....	3½ "	......
Lynchburg	Va.	.....	3½ "	......
Madison	Ill.	.....	3½ "	......
Mankato	Minn.	3 in.	......	......
Mechanicsburg	Pa.	3 in.	......	......
Meriden	Conn.	.....	3½ "	......
Milwaukee	Wis.	.....	3½ "	......
Minneapolis	Minn.	.....	3½ "	4 in.
Minot	N. D.	.....	3½ "	......
Mobile	Ala.	3 in.	......	......
Muncie	Ind.	3 in.	......	......
Navy Yard	N. Y.	.....	......	4 in.
Newark	N. J.	.....	......	4 in.
Newark Planked	N. J.	.....	3½ "	......
New Haven	Conn.	.....	3½ "	......
New Orleans	La.	.....	......	4 in.
New York City	N. Y.	.....	......	......
Bridge Dept	N. Y.	.....	......	4 in.
Bronx Borough	N. Y.	.....	......	4 in.
Brooklyn Borough	N. Y.	.....	......	4 in.
Manhattan Borough	N. Y.	.....	......	4½ in.
Queens Borough	N. Y.	.....	3½ "	......
Richmond Borough	N. Y.	3 in.	......	......
Niagara Falls	N. Y.	.....	3½ "	......
Norfolk	Va.	.....	......	4 in.
Norfolk Navy Yard	Va.	.....	3½ "	......
Norwalk	Conn.	.....	3½ "	......
Norwood	Ohio.	.....	3½ "	......
Ocean City	N. J.	3 in.	......	......
Omaha	Neb.	3 in.	3½ "	......
Owatonna	Minn.	.....	3½ "	......
Paterson	N. J.	3 in.	......	......
Pensacola	Fla.	.....	3½ "	......
Peoria	Ill.	.....	3½ "	......
Perth Amboy	N. J.	3 in.	......	......
Philadelphia	Pa.	.....	......	4 in.
Pittsburgh	Pa.	.....	3½ "	......
Poughkeepsie	N. Y.	.....	3½ "	......
Rahway	N. J.	3 in.	......	......
Reading	Pa.	.....	3½ "	......

*Depth of block at present used.

DEPTH OF BLOCKS USED.—(Continued).

City or Town.	State.	Depth.	Depth.	Depth.
Redwing	Minn.	3 in.	......	......
Roanoke	Va.	.....	3½ "	......
Rochester	Minn.	3 in	3½ "	......
Rome	N. Y.	3 in.	......	......
St. Boniface	Man.	3 in.	......	......
St. Louis	Mo.	.....	3½ in.	......
Sarnia	Ont.	3 in.	......	......
South Norwalk	Conn.	.....	3½ "	......
Spokane	Wash.	.....	3½ "	......
Springfield	Mass.	.....	3½ "	......
Springfield	Mo.	.....	3½ "	......
Stamford	Conn.	.....	3½ "	......
Syracuse	N. Y.	3 in.	3½ "	4 in.
Toronto	Ont.	.....	......	4 in.
Vicksburg	Miss.	3 in	3½ "	......
Virginia	Minn.	.....	3½ "	......
Wallingford	Conn.	.....	3½ "	......
Watertown	N. Y.	3 in.	......	......
Wenatchee	Wash.	.....	......	4 in.
Wildwood Crest	N. J.	3 in.	......	......
Wilkesbarre	Pa.	3 in.	......	......
Wilmington	Del.	.....	......	4 in.
York	Pa.	3 in.	......	......

CLYDE H. TEESDALE. *Chairman.*

F. P. HAMILTON, H. G. DAVIS,
H. S. LOUD, W. C. MEREDITH,
Committee.

CHAIRMAN CRAWFORD: This paper is now open for discussion.

MR. EDW. F. PADDOCK: There is one suggestion that I would like to make here in regard to the method of laying. The Committee speaks of the cement mortar cushion as a base. I think it would be wise to put in there also a method that is very extensively used, particularly in New England. They lay not in a cement mortar, but a dry cement sand mixture, depending upon the water filtering through the cracks of the pavement after it is laid to make the mortar set. Lower down on the same page they speak of streets on which traffic is very severe in New York, stating that no expansion joints are used in New York City. I might say that on these streets buckling is very prevalent.

Whether it is due to the fact that they are not using expansion joints I cannot say, but buckling is very common and very troublesome there. There is hardly a day that we do not see trouble of this kind on some of the downtown streets in New York.

MR. W. DE BERARD: Mr. President, there is nothing said here in regard to laying wood blocks directly on concrete without any cushion at all. That practice has been started in Chicago in front of the postoffice. One-half of the block, that is, from Jackson Boulevard up to Quincy Street, was laid on the concrete after it had been smeared over with tar; the other half was laid directly on the bare concrete and the only trouble was the added expense of getting a smooth surface of concrete.

MR. H. L. COLLIER: Mr. Chairman, I have prepared a few remarks on this report which I desire to submit.

CHAIRMAN CRAWFORD: We would be glad to have you read them.

DISCUSSION ON WOOD BLOCK PAVING.

By H. L. Collier.

Committee No. 3 has given much labor to the presentation of its report, which should be duly appreciated.

The A. W. P. A. has made such wonderful progress and now occupies a position so exalted among its co-ordinate associations that anything emanating from one of its standing committees carrying the stamp of approval, the O. K. of the Association, should be absolutely accurate.

I have so high an opinion of the membership of the Association that I think during the year 1915 we should, through our standing committees, mature a full set of specifications, certainly for creosoted wood block paving, giving the method of treatment, the creosote oil, the amount of oil per cubic foot of timber, the foundation, the cushion, the filler, the way in which the blocks shall be laid, not the best and the next best, the best only. Let each declaration be so explicit, so positive that other associations will accept them without question.

Every member of this Association should be an enthusiastic wood block paving promoter, each should thoroughly understand the best method of treatment, of construction and of maintenance. There is no better way to advertise the science of wood-preservation. Everyone traversing a well-constructed wood block pavement takes note of it, not so with any other branch of the business. There is no doubt that a properly constructed creosoted wood block pavement is the best of all pavements, suited alike to the heavy traffic business streets and first-class resident avenues; carelessly constructed there is none so trouble-

some. As to the first cost, it is one of the most expensive, but if carefully constructed a life of from 15 to 20 years will be insured, and its low cost of maintenance will make it the cheapest of first-class pavements.

To attempt to make it cheap in first cost will, with absolute certainty, make it a failure. Better let some other paving material be accepted rather than let up on any of the essentials of a good wood block pavement.

Strange as it may seem one failure in wood block paving will offset many perfectly satisfactory jobs, as has been proven in my own city, Atlanta, in Little Rock and in Mobile.

The failures in Little Rock last year alone caused by cheap construction will cost the industry more than will be saved by cheap construction over first-class construction in any city during the next year. The industry would have saved tremendously had not a yard of creosoted wood block pavement been laid in Little Rock during 1913 and 1914. It is suicidal to use inferior oil, to give inadequate penetration, to employ cheap construction in a creosoted wood block pavement.

Could I have my way I would punish the engineer and the contractor for every failure in wood pavements. There is no uncertainty as to the satisfaction of a properly constructed wood block pavement. This I firmly believe. Longleaf yellow pine lumbermen would seriously object to the statement that the wood block pavement of Des Moines was made of longleaf yellow pine blocks so unsatisfactory has it been. It is true there are three city blocks and three bridges paved with longleaf pine blocks and they are perfectly satisfactory. The yellow pine owners would be glad to be given the credit of having furnished a very large percentage of the wood blocks of Chicago, only one street, Congress, between Wabash and Michigan Boulevard, a short city block, has been paved with black gum so far as I am informed. We are also informed that most of the wood block paving in Milwaukee is made of longleaf yellow pine blocks.

MR. CLYDE H. TEESDALE: In connection with the tabulation for the City of New York we now have figures from the Borough of Manhattan, the Borough of Queens and the Borough of Richmond, which completes Greater New York.

MR. H. S. LOUD: Mr. Chairman, the gentleman mentioned mortar cushion. The mortar cushion used generally is practically a dry mixture of sand and cement and depends upon sprinkling for enough water to set. I know of no case where a wet mortar is used. The report makes no recommendations whatever, just states what we found, and we thought it was of importance to state that the Borough of Manhattan [New York City] did not make any provision for expansion.

The fact that they have a lot of buckling is due to the fact that they will not make those provisions.

CHAIRMAN CRAWFORD: Mr. E. R. Dutton, assistant city engineer of the City of Minneapolis, has written a discussion and sent it in to the Association. I am going to ask our Secretary to read this paper. The City of Minneapolis has used a great deal of wood paving block and has given a good deal of attention to the study of this subject.

Secretary Angier then read the discussion as follows:

DISCUSSION ON WOOD BLOCK PAVING.

By E. R. Dutton.

I was quite interested in the report of the Committee on Wood Block Paving, and particularly so in regard to the amount of wood block paving in the different cities in the United States.

From the analysis of these figures I find that there is a total of about 8,670,000 square yards in the United States, and that the city of Minneapolis has about one-eighth of all the wood block paving in the United States. There are nine cities in the United States, according to this table, which has over 200,000 square yards of wood blocks. All of these cities are in the Middle West, South and Southwest, so that the creosoted wood block industry seems to be more in the West than in the East. The City of Minneapolis last year laid about 205,000 square yards of wood blocks.

This is the first compilation that I have seen of the amount of wood block paving in the various cities, and if the report contained nothing else but this it would be of very much interest to the engineers and manufacturers.

MR. CLYDE H. TEESDALE: We sent out letters only to the larger cities and towns, and some of them did not reply. There are many smaller cities and towns which have considerable areas of wood block pavement that were not written to. Consequently, there is a considerable amount of paving in the United States which is not itemized in our report.

CHAIRMAN CRAWFORD: Is there any further discussion on this Committee report? I see Mr. Larkin has just come into the room. Mr. Larkin has had a good deal of experience with wood block paving, and we would like to hear from him.

MR. A. E. LARKIN: I have been busy in the Committee meeting out there, and I have not had a chance to see just how far this matter has gone. There is one thing that I would like to know and that is

what part of Mr. Teesdale's report is to be accepted and endorsed by the Association?

CHAIRMAN CRAWFORD: If there is no further discussion on this subject I am going to ask Mr. Teesdale to read his recommendations again. I understand from the Committee that they are presenting the written report that has been placed in the hands of members of the Association as information and desire the recommendations which Mr. Teesdale read in presenting this report to be adopted by the Association. I will ask Mr. Teesdale to read those recommendations again.

(Mr. Teesdale then read the recommendations.)

CHAIRMAN CRAWFORD: You have heard the Committee's report. I would like to know the wish of the Association, whether this shall be accepted as presented or not. Will someone make a motion?

MR. FRANK W. CHERRINGTON: Mr. President, I move that the Association adopt the recommendations of the Committee and accept the remainder as information.

MR. F. D. MATTOS: I second the motion.

CHAIRMAN CRAWFORD: You have heard the motion. Are there any remarks? All in favor of the motion will signify it by saying Aye; contrary, No. The motion is carried. With the thanks of the Association the Committee is excused.

Mr. Teesdale has written a paper on the "Bleeding and Swelling of Paving Blocks," and I am going to ask him to read that paper at this time, as it follows very nicely the Committee's report.

MR. CLYDE H. TEESDALE: I do not care to occupy the time of the members in going into details as to the methods we adopted in making these experiments, and if it meets with the pleasure of the Association I will proceed at once with the general discussion in the latter part of the report. If anyone would like to have me discuss the methods we have adopted, however, I should be glad to do so.

MR. L. B. MOSES: Mr. President, I am sure that everybody here is interested in how the Government laboratory deals with the questions involved in treating paving blocks. This matter of paving blocks is one of the most important things that we have here. We ought not to cut everything short, especially these important points. There are a lot of us who have waited for this paper, which has a very important bearing on our work. If Mr. Teesdale could give it to us I am sure we would be glad to hear it.

THE BLEEDING AND SWELLING OF PAVING BLOCKS.

By Clyde H. Teesdale.

Introduction.

Numerous theories have been advanced to account for the bleeding and swelling of paving blocks. In many cases these were unsupported by facts, and did not give rise to methods that prevented the trouble. Work was, therefore, started at the Forest Products Laboratory to determine, if possible, the cause of the difficulties and to devise methods of preventing them.

The laboratory tests indicated that both bleeding and swelling might be greatly reduced by the adoption of suitable methods of treating and handling the blocks. Since these experiments were limited to two blocks in each test, they could not, taken by themselves, be considered conclusive. When the laboratory experiments were completed, therefore, arrangements were made to lay an experimental pavement in co-operation with the Kansas City Terminal Railway Company, at Kansas City, Mo. The blocks were treated by the Ayer and Lord Tie Company during the first part of August, 1914. A portion of the oil used was furnished by the Barrett Manufacturing Company. The blocks were laid in October, too late in the year to obtain much information on bleeding and swelling.

Part I—Bleeding Tests.

The investigation of bleeding was intended to include those factors entering into the selection of material and its treatment at the plant that might have an influence on bleeding. Briefly, these were the following:

1. Species and rate of growth.
2. Moisture condition of the wood when treated. Green and air-dried wood was tested.
3. Character of preservative used. A distillate creosote oil and a mixture of this with tar, the latter intended to be representative of the grade of paving oil in general use, were tested.
4. Manipulative methods employed in treatment, especially the use of steam and vacuum treatment and preliminary air pressures. In addition, tests were made to determine the effect of varying the absorption of preservative, and of subjecting treated blocks to external pressure, a condition sometimes obtained in a street when the expansion trouble exists.

Materials Used.

Wood.

Green longleaf pine and thoroughly air-dried* longleaf pine, rapid growth loblolly pine, and eastern hemlock blocks, 4" x 8" x 4" were

*The moisture content of the air-dried wood was not determined. This material was air-dried when received, and was held in the laboratory for nearly a year before making tests. It was, therefore, thoroughly air-dry.

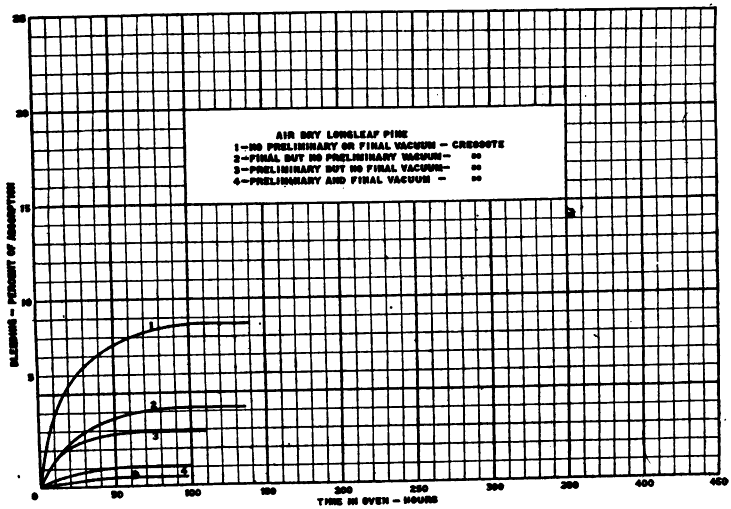


Fig. 1.—Effect of vacuum on bleeding.

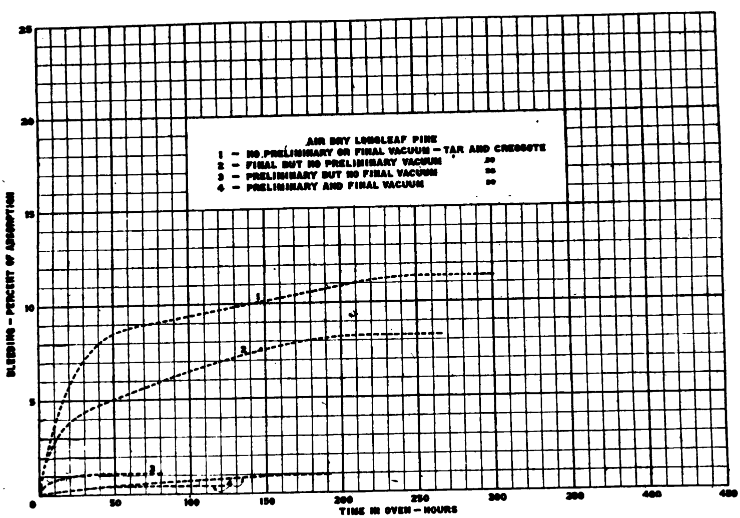


Fig. 2.—Effect of vacuum on bleeding.

used in the work. The longleaf pine was regular paving block stock; the other material was sawed from ties.

Preservatives.

Two preservatives were used in the investigation of bleeding. One was coal-tar creosote with a specific gravity of 1.07 at 60° Centigrade. The other was a 50 per cent. mixture of this creosote with a by-product coke-oven tar having a specific gravity of 1.17 at 60° C., and containing about 6 per cent. free carbon. This mixture was believed to be comparable to much of the paving oil used for treating blocks. The analyses of these oils are given in the appendix.

Method of Conducting the Work.

Careful matching of specimens was necessary, because of the limited number of tests made. It has been found that under similar conditions the most uniform absorptions and penetrations are obtained when the specimens are matched lengthwise with the growth of the tree. This method of matching was, therefore, adopted in these tests. In the case of longleaf pine, paving stock 4″ x 8″ x 20′ was used, and all of the blocks cut from one stick were considered matched with each other. In the case of the other species ties were cut into sticks 4″ x 7″ and all of the specimens from one of these sticks were considered matched.

The blocks were treated in a small experimental cylinder in which the pressure and temperature conditions were under accurate control. The preservative was applied to the blocks under a pressure of 140 pounds per square inch until the desired absorption was obtained. A temperature of 180° F. was maintained throughout the treatment. When preliminary vacuums were drawn, the period was one hour, and the intensity 26 inches unless otherwise stated. Steam periods and pressures are stated on the figures in each case. Two blocks were included in each treatment.

Method of Making Bleeding Tests.

After treatment the blocks were placed in an oven in tin boxes, and subjected to a constant temperature of 120° F., until the oil ceased to bleed from them. Blotting paper was used to absorb the oil as it came from the blocks. Weights were taken at suitable intervals, corrections being made for losses by volatilization. In the data presented, an average of two blocks was taken in each case.

Discussion of Results.

The results obtained from the bleeding tests are given in the attached curves, the measure of bleeding being taken as the gain in weight of blotting paper in per cent. (of the original absorption) of the block. Since the absorption in each case was about 16 pounds

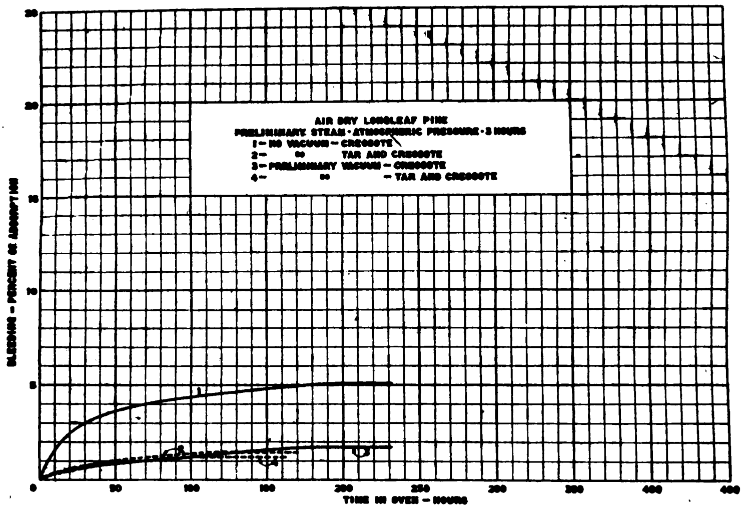


Fig. 3.—Influence of steaming on bleeding.

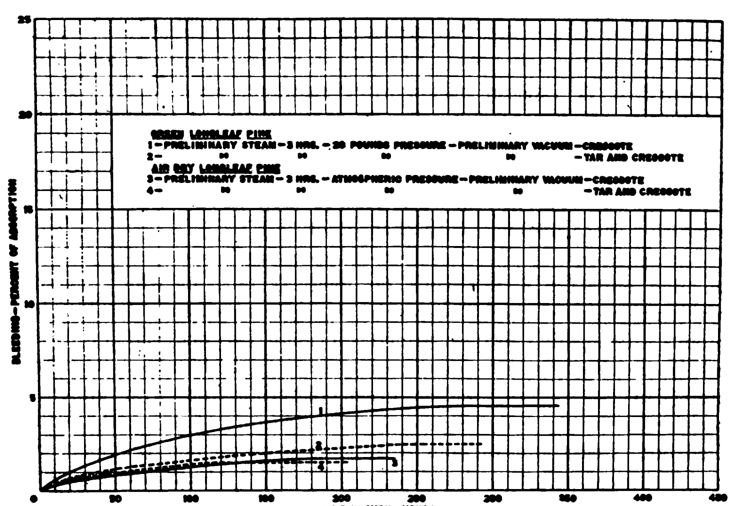


Fig. 4.—Bleeding of green and air-seasoned blocks.

per cubic foot (except when the effect of absorption on bleeding was studied), the results are considered comparable with each other, and no corrections were made for the slight variation obtained. In the following remarks air-dried longleaf pine is referred to unless otherwise stated. The data on blocks treated with creosote are shown in solid lines, and on those treated with tar and creosote mixture in dotted lines.

The effect of the use of vacuum periods on bleeding is shown in figures 1 and 2. All of the results given in both figures were obtained on matched specimens and are, therefore, comparable with each other. In every case a preliminary vacuum was more effective than a final vacuum. Two check runs are shown in Curve 4, figures 1 and 2. The least bleeding, however, was obtained when both vacuum periods were used. The results shown on figures 5 and 8 also show the effect of vacuum on the bleeding of loblolly pine and hemlock. The results indicate that a preliminary vacuum especially is a very important factor in treating air-dry paving blocks if bleeding is to be reduced.

The influence of steaming on bleeding is shown in figure 3 in the case of air-dry longleaf pine. These curves should be compared with Curve 1 in figures 1 and 2, all of the blocks being matched with each other. Steaming, when used without a vacuum period (Curve 1), was not very efficient in reducing bleeding when creosote was used. With the tar and creosote mixture, however (Curve 2), the reduction in bleeding was very marked. Steaming evidently has a much greater effect on the tar and creosote mixture than on the creosote.

The use of steam followed by a preliminary vacuum is also shown in figure 3. A vacuum period after steaming assisted somewhat in reducing bleeding, especially when creosote was used (compare Curves 1 and 2). With either preservative bleeding was almost negligible. It should be noted that a vacuum period is necessary after steaming the blocks in order to remove excess of moisture. All of our blocks in figure 3 were matched with each other.

Comparisons of the bleeding of green and seasoned blocks are available only for a few runs on longleaf pine in which steaming treatments were made. The results are given in figure 4. The least amount of bleeding was obtained on air-dried material (Curves 3 and 4) and the greatest amount on green material treated with creosote (Curve 1). With either green material, and with either the creosote or the tar and creosote mixture, bleeding was greatly reduced when both steam and vacuum treatments were applied (compare with results shown in figures 1 and 2). All air-dry blocks were matched, and all green blocks were matched. The air-dry blocks, however, were not matched with the green ones.

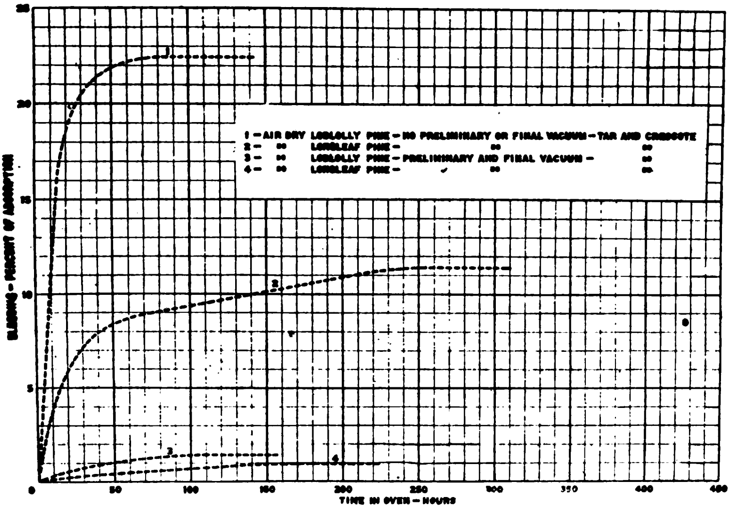


Fig. 5.—Bleeding of longleaf pine and rapid growth loblolly pine blocks.

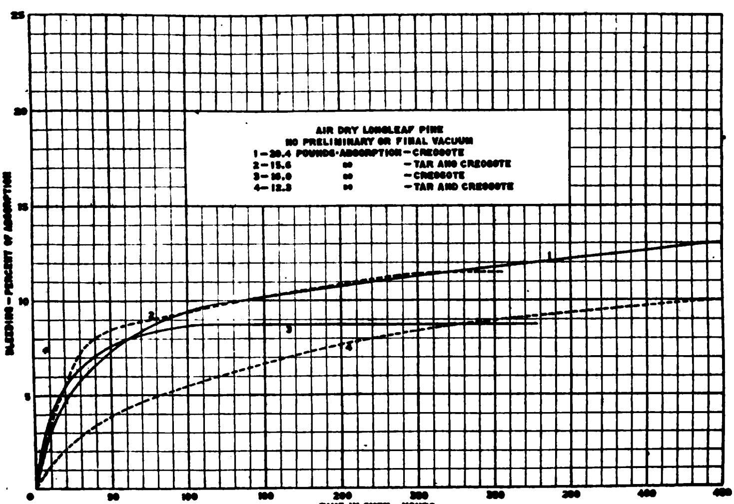


Fig. 6.—Effect of varying absorption on bleeding.

The influence of rate of growth was studied only by comparing the results of the tests on longleaf pine and rapid growth loblolly pine in figure 5. It will be noted that the loblolly pine bled very much more than the longleaf pine when no preliminary vacuum was used. When preliminary vacuum was used, the absorption could not be controlled and 40 pounds per cubic foot were absorbed. While the per cent. of bleeding was reduced the total amount of bleeding was, therefore, still very large.

The influence of the amount of preservative injected is shown in figure 6. Bleeding was materially increased when absorption was increased, especially when more than 16 pounds per cubic foot were injected*, or when the tar and creosote mixture was used. Compare Curve 1 with 3 and Curve 2 with 4; additional data on this point were also obtained, but are not included because of lack of space.

The effect of outside pressure, intended to show the effect of the expansion of blocks in the street on bleeding, did not appear to have much influence on bleeding. The blocks in this case (air-dry longleaf pine) were compressed in an iron clamp until the wood was crushed. This extreme condition would not be reached in the street. Nevertheless, bleeding was not greatly increased. The results are given for both oils in figure 7. Compare Curve 1 with 3 and Curve 2 with 4; Curve 1 cannot be compared with 2, nor Curve 3 with 4 as the blocks were not matched in this way.

The bleeding of oil from hemlock is shown in figure 8; without the use of vacuum, bleeding was very severe (Curves 1 and 2)). A preliminary and final vacuum, however, reduced it to a minimum (Curves 3 and 4). All of these blocks were matched with each other.

The effect of mixing tar with creosote is shown by comparing the results in all of the figures from 1 to 6, inclusive. When no preliminary vacuum or steam treatments were used, the blocks treated with tar mixtures in most cases bled considerably more than those treated with creosote; this was true regardless of species (see figures 1, 2, 5 and 6). Steaming blocks prior to treatment appeared to have a very marked retarding influence when tar was used (see figures 3 and 4). The tar appeared to dry in the outer pores of the wood, forming a mat that retarded bleeding.

The use of a final steam bath did not influence the bleeding materially, but removed carbon from the surface, and greatly improved the appearance of blocks treated with the tar mixture. The data on this point are not given in the figures.

All of the results seem to indicate that bleeding is caused to a large extent by the expansion of air in the wood cells. Other con-

*It should be noted that when the absorption was increased, the amount of bleeding could also increase without showing an increase in the per cent. of bleeding.

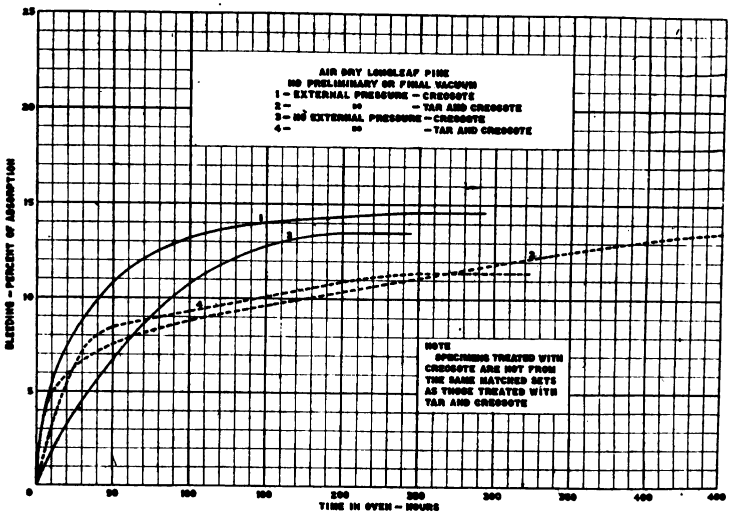


Fig. 7.—Effect of external pressure on bleeding.

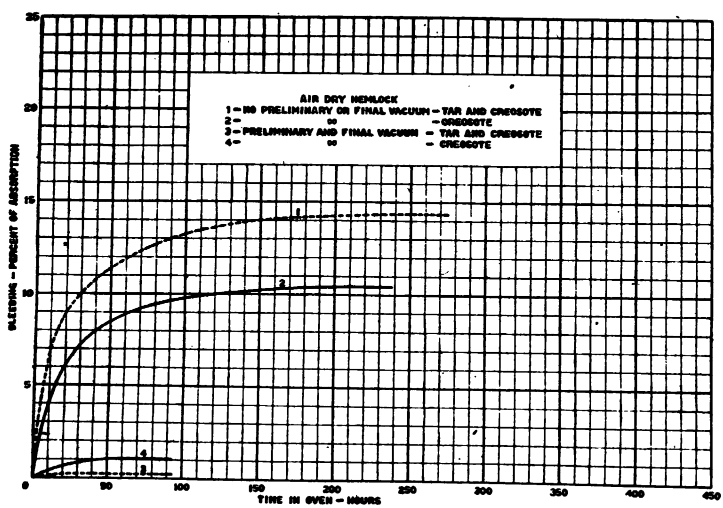


Fig. 8.—Bleeding of air-dry hemlock blocks.

tributing causes which no doubt aggravate bleeding are expansion of the preservative in the wood, external pressure exerted upon the blocks, excessive absorption of preservative by some of the blocks, and the use of rapid growth woods. Sapwood is also a factor, largely because of the excessive absorption of oil that it takes.

Part II—Swelling Tests.

The investigation of swelling was divided into two series of tests. The first series was made to determine the effect on swelling of various percentages of tar, and also of free carbon in mixtures of tar and creosote. This is discussed in Part IIA. The second series (Part IIB) was made to determine the influence of varying the method of treatment on swelling. All of the blocks in the first series, and one-half of those in the second series, were soaked in water after treatment until they ceased to expand. In order to correlate these results more closely with service conditions, the remainder of the blocks in the second series were placed on a sand cushion and sprinkled with water twice each day until they ceased to change in size.

Part II A—Materials Used.

Wood.

Two sticks of thoroughly air-dried longleaf pine were cut into blocks 4"x4"x8'. After the blocks were cut they were piled in the laboratory for several months before treatment to insure a uniform moisture condition. For each treatment given one block was used from each stick thereby giving two blocks treated with the same preservative, the results of which are averaged in the curves.

Preservatives.

The following preservatives were used in this experiment:

1. A coal-tar creosote having a specific gravity of 1.07 at 60° Centigrade. (The same as used in the bleeding test.)

2. A by-product coke oven-tar containing 6 per cent. of free carbon and having a specific gravity of 1.184 at 60° Centigrade. (The same as used in the bleeding tests.)

3. A by-product coke oven-tar containing 16 per cent. of free carbon and having a specific gravity of 1.232 at 60° Centigrade.

4. A gas-house tar containing 30 per cent. of free carbon and having a specific gravity of 1.273 at 60° Centigrade.

The carbon was removed from a portion of these tars with chloroform. (See paper by F. M. Bond, Proceedings American Wood Preservers' Association, 1913, for method used.) These carbon-free tars were then mixed with the above coal-tar creosote (No. 1) in proportions as follows:

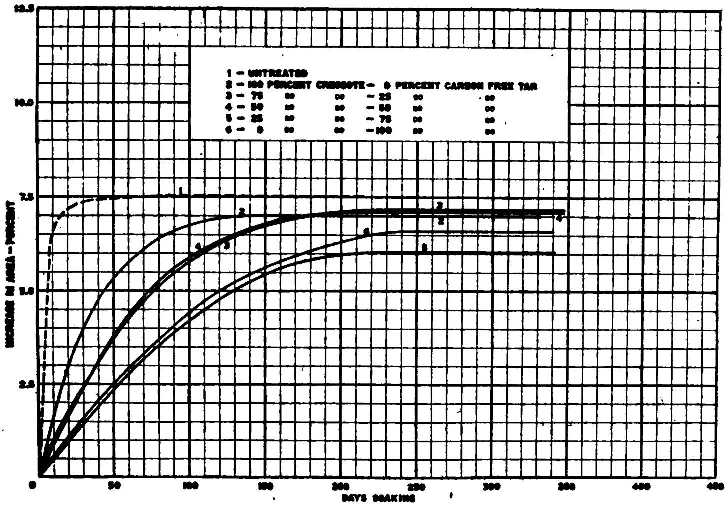


Fig. 9.—Effect on swelling of using various mixtures of creosote with carbon-free tar (specific gravity 1.184).

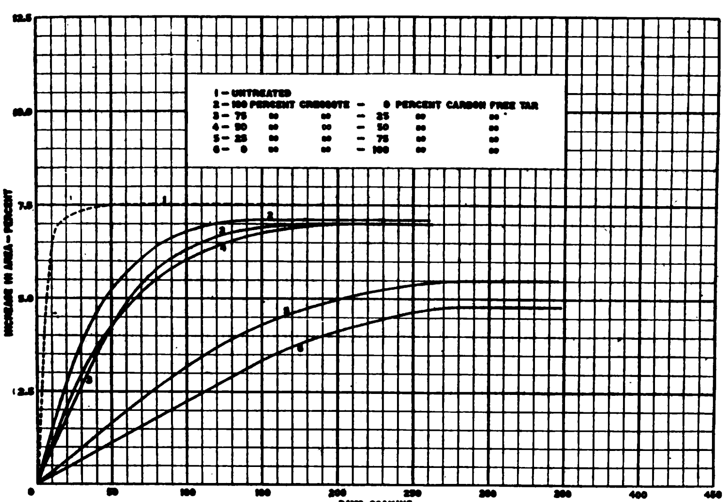


Fig. 10.—Effect on swelling of using various mixtures of creosote and carbon-free by-product tar (specific gravity 1.232).

CREOSOTE	CARBON-FREE TAR
Per cent. of total mixture by volume.	Per cent. of total mixture by volume.
100	0
75	25
50	50
25	75
0	100

In the tests to determine the influence of free carbon on swelling, the carbon-free tar was mixed with the original tar in various proportions. The per cent. of carbon in these mixtures was determined by analysis. These tars were then mixed with coal-tar creosote, the proportions being 50 per cent. creosote and 50 per cent. tar in each case. In this manner it was possible to obtain a series of oils, the composition of which was the same except for the content of free carbon.

Method of Conducting the Work.

Each block was treated until an absorption of about 16 pounds per cubic foot was obtained. The pressure and time of treatment were varied during the treating period to secure the desired absorption of the different preservatives. No preliminary or final vacuums were employed. The temperature of the preservatives during treatment was approximately 200° Fahrenheit.

Method of Making Swelling Tests.

After treatment brass tacks were driven into each face of the blocks to facilitate measuring. All measurements were made over these tacks with a vernier caliper to .001 inch. The blocks were then placed in a tank of water, and allowed to soak until they ceased to increase in area. Measurements were made at frequent intervals at first, these intervals being lengthened when the blocks changed in volume less rapidly.

After the tests were completed, the per cent increase in area of the transverse section of each block was computed for each period at which weights and measurements were taken, and the results plotted in curves. The area thus measured may, for our purpose, be considered comparable to the area of the surface of the blocks when laid in the street.

The time of soaking in days was used as abscissae, and the per cent. increase in area as ordinates.

Discussion of Results.

Mixtures Using Carbon-Free Tar.

Figures 9 to 11, inclusive, show the results obtained on carbon-free tars mixed with creosote. Curves showing the results obtained on

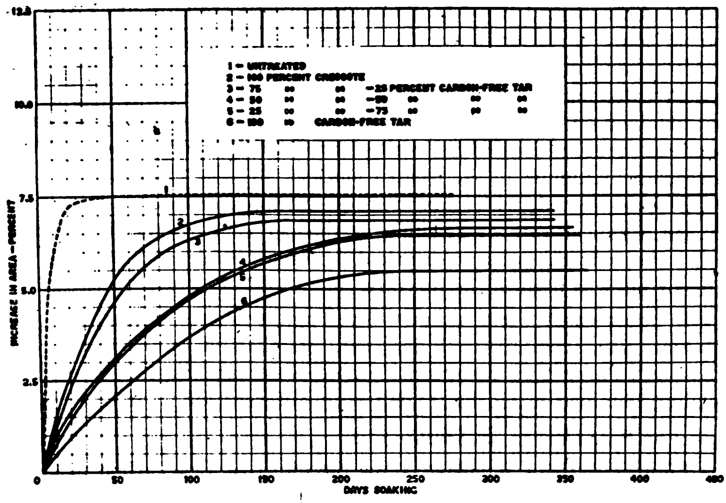


Fig. 11.—Effect on swelling of using various mixtures of creosote and carbon-free gas-house tar (specific gravity 1.273).

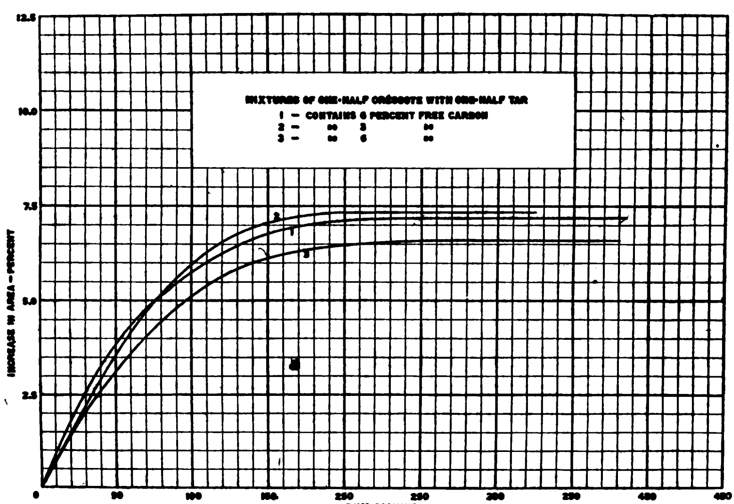


Fig. 12.—Effect on swelling of using a mixture of creosote and by-product tar (sp. gr. 1.184) containing various amounts of free carbon.

untreated wood, and wood treated with straight creosote are given for comparison.

It is evident that the rate of swelling was considerably retarded in the treated blocks, and that the maximum swelling was not as great as that obtained on untreated blocks. The maximum swelling of untreated wood was reached in 40 days, while from 5 to 10 months were required to reach a maximum in the treated blocks.

Blocks treated with mixtures of carbon-free tar and creosote showed a slower rate of swelling as the per cent. of tar in the mixture increased; this was not marked, however, until from 50 to 75 per cent. of tar was used in the mixture.

In most cases the maximum swelling of blocks treated with tar mixtures was from 10 to 25 per cent. less than in those treated with creosote. There was also considerable difference in the amount of swelling obtained in blocks treated with different kinds of tars.

Effect of Free Carbon on Swelling.

Figures 12 to 14, inclusive, show the effect of free carbon in tar on swelling. The blocks were treated with the 50 per cent. creosote and 50 per cent. tar mixtures in which the per cent. of free carbon was varied. Figures 12 and 13 indicate that the free carbon in the by-product tars had little effect on swelling. Figure 14 indicates that the free carbon in the gas-house tar tended to retard swelling to a slight extent.

Character of Penetration.

After the soaking tests were concluded, each block was split to determine the character of penetration. In most cases the penetration was quite uniform through the blocks. It had been necessary, however, in making the treatments, to greatly increase the time and intensity of pressure, as the percentage of tar was increased in the mixture, to obtain the required absorption

Part II B—Effect of Varying Method of Treatment on Swelling.

Materials Used.

Wood.

Air-dry longleaf pine, green longleaf pine, and air-dry rapid growth loblolly pine were used. All of the blocks were cut from the heartwood. The seasoned material was obtained in an air-dry condition, and after being cut into blocks, was seasoned in the wood-preservation laboratory for several months before being treated.

Preservatives.

Creosote, and a mixture of 50 per cent. creosote and 50 per cent. by-product tar were used. These oils were the same as those used in the bleeding tests (Part I).

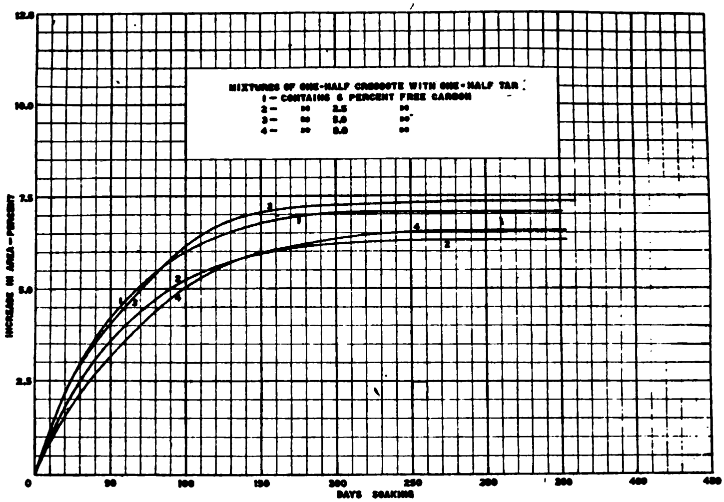


Fig. 13.—Effect on swelling of using a mixture of creosote and by-product tar (sp. gr. 1.232) containing various amounts of free carbon.

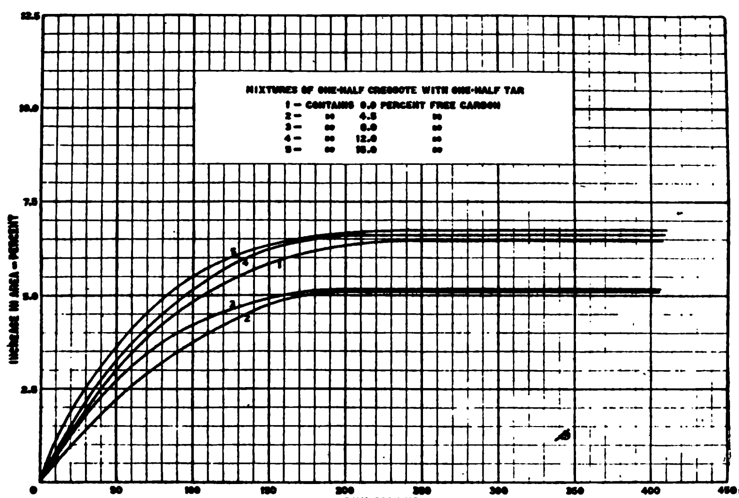


Fig. 14.—Effect on swelling of using a mixture of creosote and gas-house tar (specific gravity 1.273) containing various amounts of free carbon.

Method of Conducting the Work.

The following treatments were made with each preservative on seasoned longleaf pine, using 10 pounds and 16 pounds per cubic foot absorptions in each case:

1. No preliminary or final vacuum.
2. Preliminary but no final vacuum.
3. Final but no preliminary vacuum.

In the case of green longleaf pine and air-dried loblolly pine, treatments were made with each preservative using no preliminary or final vacuum, but with absorptions of 10 and 16 pounds per cubic foot.

A temperature of about 180° F., and a pressure of about 135 to 140 pounds per square inch were used throughout the treatments, except in the case of seasoned loblolly pine, when the pressure varied from atmospheric to 25 pounds per square inch. Twenty-eight-inch vacuums were employed.

The methods of measuring volume, and of showing changes in volume by means of curves are the same as described in Part II A.

The air-dried blocks were cut from three sticks. All blocks from a given stick were considered matched with each other. Three blocks from each stick or a total of 9 blocks were included in each treatment. After treatment one block from each stick was soaked in water, one was placed upon a sand cushion* and sprinkled twice daily, and the third was split to determine the character of the penetration. The results on swelling from three blocks in each treatment (one from each stick) were averaged, and plotted in the attached curves.

In this manner, the blocks in the various curves were matched with each other, but those averaged for a given point in each curve were not matched, this not being considered essential.

Discussion of Results.

Effect of Vacuum on Swelling (Air-dry Longleaf Pine).

(*a*) *Soaking Tests.*—The effect of vacuum on swelling is shown in figure 15 when approximately a 10-pound absorption was used, and in figure 16 when approximately a 16-pound absorption was used. Dotted lines are for the creosote and tar mixture, and solid lines are for the creosote.

The results are not very consistent, but they indicate that the air-seasoned longleaf pine blocks treated with either oil did not swell as much if given a preliminary vacuum, as when no vacuum period or final vacuum was given. Also that blocks treated with the creosote and tar mixture swelled less than those treated with creosote, unless a preliminary vacuum was used. No difference in swelling was indicated between

*In this case the tacks were placed 1 inch from the bottom of the block, and measurements made as in the soaking tests.

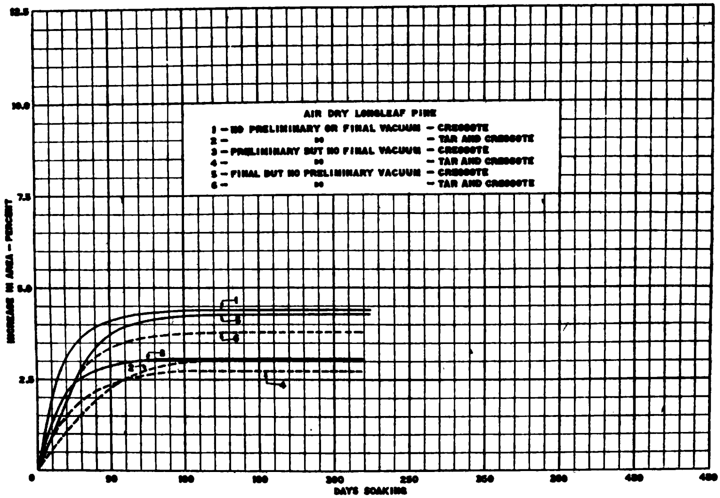


Fig. 15.—Effect of varying absorption on swelling (soaking test).

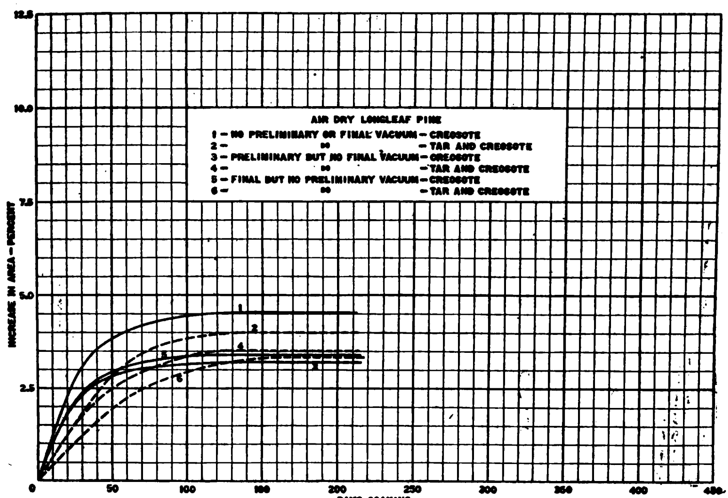


Fig. 16.—Effect of vacuum on swelling using an average absorption of about 16 pounds per cubic foot (soaking test).

the 10 and the 16 pounds treatment except that the results obtained from the latter were more consistent, due probably to more uniform penetration.

(*b*) *Blocks Placed on Sand Cushion.*—The results in this case are shown in figure 17 when a 10-pound treatment was used, and in figure 18 when a 16-pound treatment was used. The results in the former case are inconsistent probably because of uneven penetration due to the lighter absorption of oil. In general, a tendency for a preliminary vacuum to reduce swelling is indicated. The blocks treated with the tar mixture, in general, swelled about two-thirds as much as those treated with creosote. Swelling was also much less than in the blocks soaked in water.

Effect of Varying Absorption of Oil on Swelling (Air-dried Loblolly Pine).

These results are shown in figure 19 for the soaking tests, and figure 20 for blocks placed on the sand cushion. There is no indication that increasing absorption decreases swelling in either case. In general, the blocks treated with the creosote and tar mixture swelled less than those treated with creosote alone.

Similar tests were made on green blocks. Practically no swelling was noted, and the curves were not drawn in this case.

Swelling in Top and Bottom of Blocks (Sand Cushion Test).

Measurements were made on a few of the blocks placed on the sand cushion to determine the difference in swelling between the top and bottom of the blocks. In all of the previous tests the tacks were placed 1 inch from the bottom face. In this test, additional tacks were placed 1 inch from the top. The results are shown in figure 21.

The curves, as well as the appearance of the blocks themselves show very strikingly the greater amount of swelling that occurred in the bottom of the blocks. This in some cases is very probably a cause of buckling, especially where the pavement has considerable crown, due to the upward force liable to be exerted if the bottom of each block expands more than the top. This is liable to occur if water penetrates the filler and reaches the sand cushion. Plate 1 shows a photograph of blocks in which the bottom has expanded more than the top.

The following conclusions on swelling were drawn as a result of the tests:

1. The rate of swelling was much slower in treated blocks than in untreated blocks. In all cases where the blocks were soaked in water, however, the *maximum* swelling finally obtained was at least two-thirds, and in most cases was only slightly less than that of untreated wood.

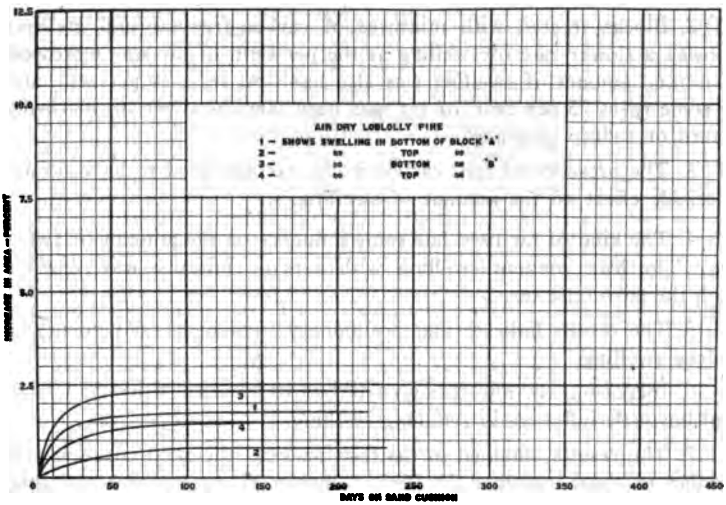


Fig. 17.—Effect of vacuum on swelling using an average absorption of about 10 pounds per cubic foot (sand cushion test).

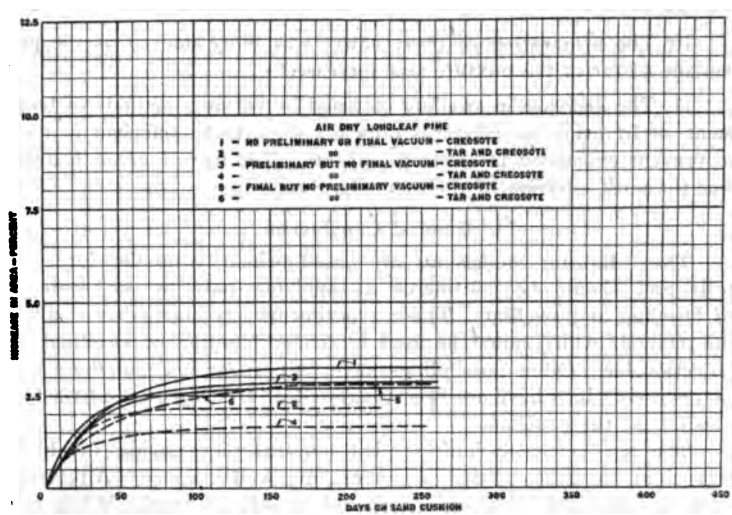


Fig. 18.—Effect of vacuum on swelling using an average absorption of about 16 pounds per cubic foot (sand cushion test).

2. Blocks treated with mixtures of carbon-free tar and creosote showed a slower rate of swelling as the per cent. of tar was increased. The total amount of swelling was also less. At least 50 per cent. and in some cases 75 per cent. of tar was necessary, however, to markedly retard or reduce swelling.

3. The presence of free carbon in the tar appeared to have no appreciable effect on the amount of swelling.

4. The kind of tar used has some influence on the amount of swelling. The least amount swelling with a given mixture was obtained with the gas-house tar.

5. The results indicate that preliminary vacuum has a tendency to reduce swelling.

6. Increasing the absorption of oil above 10 pounds per cubic foot had but little influence in reducing swelling.

7. The results obtained in the test made on the sand cushion were similar to those obtained in the soaking tests except that the total amount of swelling was less.

8. No swelling was obtained in blocks treated in the green condition.

9. It was possible to obtain the desired absorption by increasing the time and pressure of the treatment as the percentage of tar was increased.

10. The penetration of preservative was more uneven as the percentage of tar in the mixture was increased.

11. The decrease in swelling obtained by varying methods of treatment, or by using tar mixtures does not seem to be sufficient in itself to prevent expansion in street pavements. The use of green material was the most effective of the methods tested.

General Conclusion.

The following conclusions are based primarily on the foregoing tests and should be considered as applying only to the problems of bleeding and swelling. These experiments have not covered all of the methods which might be used to render bleeding or swelling less objectionable. Other possibilities have been suggested and there may be methods which have not been suggested of arriving at a satisfactory solution of the problem.

The tests seem to indicate that longleaf pine paving should be treated in the green condition after being well steamed. All blocks, even if thoroughly air-seasoned should be well steamed. While it is true that a preliminary and final vacuum greatly retarded bleeding and to some extent the swelling of air-seasoned wood, a preliminary va-

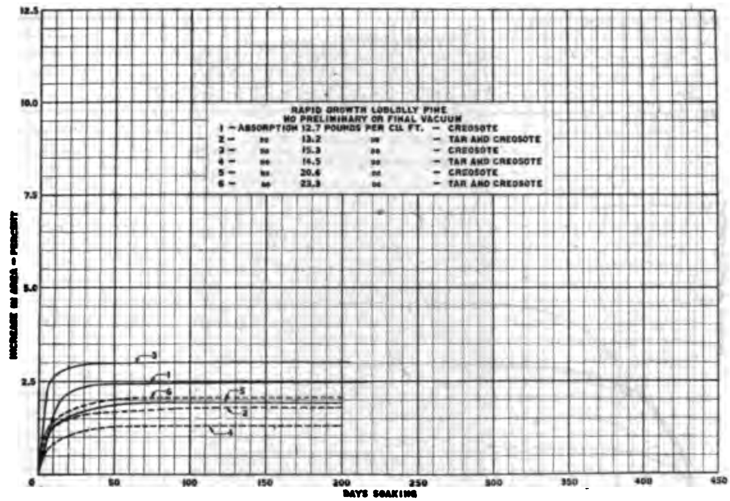


Fig. 19.—Effect of vacuum on swelling using an average absorption of about 10 pounds per cubic foot (soaking test).

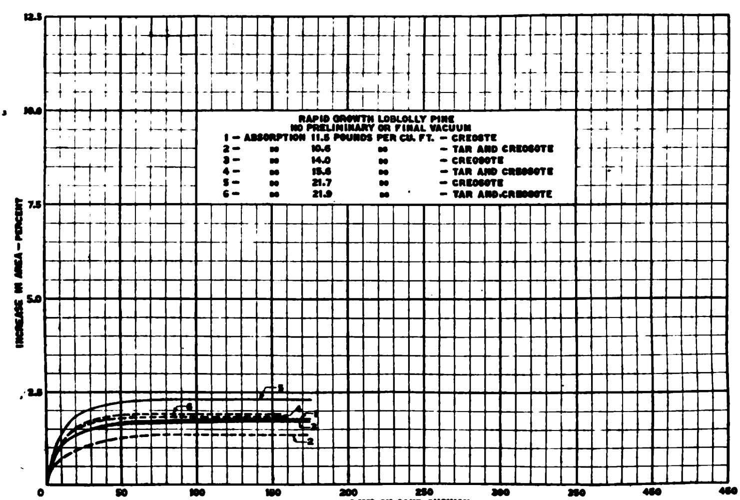


Fig. 20.—Effect of varying absorption on swelling (sand cushion test.)

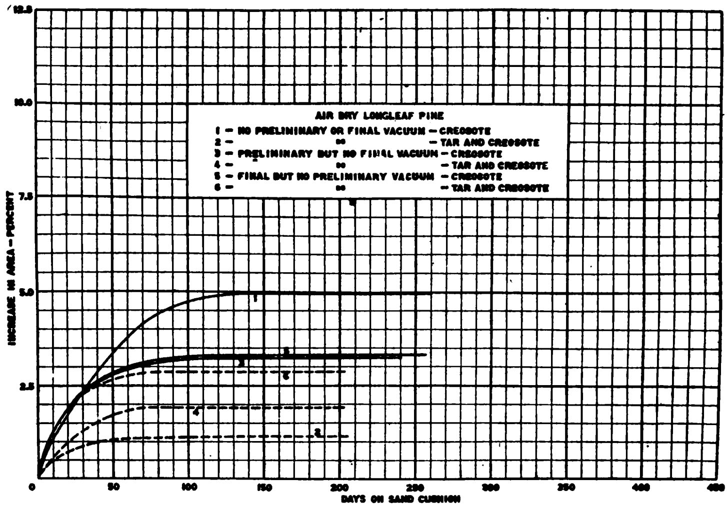


Fig. 21.—Difference in swelling of top and bottom of blocks (sand cushion test).

cuum will tend to make the absorption of oil too rapid during treatment, resulting in uneven penetration. A steaming period is, therefore, advisable to render the absorption less rapid and allow a longer and more intense pressure period to be applied. Furthermore, if seasoned blocks are steamed, they will take up moisture and expand and should be less liable to give trouble from swelling after laying in the street. For these reasons it would be preferable to treat green material when it is possible to obtain it.

If for any reason the blocks cannot be laid soon after treatment, they should be covered and perhaps wet down occasionally to prevent them from drying out. It is likely that if the blocks are wet when laid, expansion troubles will be much reduced, provided a good job of laying is done.

It would seem to be desirable to give a vacuum treatment after the steaming period and also after the oil has been removed from the cylinder. If tar mixtures are used, a final steam bath should succeed the final vacuum to remove carbon and dirt from the blocks.

Absorptions of over 16 pounds per cubic foot hardly seem necessary. Data are available which indicate that heavier absorptions do not greatly retard swelling and that they tend to increase bleeding.

It seems very likely that the reasons why some pavements bleed while others do not may very often be traced to the method used in treatment. A plant treating green material would resort to a steaming and vacuum treatment with the probable result that the blocks would

Blocks showing greater swelling in bottom. This is probably a cause of the buckling of pavements in some cases.

give no trouble. The same plant, perhaps, would later treat seasoned material without steaming it or giving it a vacuum treatment. This would be the simplest method of treating such timber as much time would be saved, and these operations would seem unnecessary.

These tests do not indicate that the use of tar mixtures will prevent swelling, although they tend to retard it. The least swelling was obtained with large amounts of gas-house tar having a high viscosity and specific gravity. Previous tests, however, have shown that such tar mixtures greatly retard penetration. The tars most suitable for mixing with creosote, when their penetrating qualities are considered, are those having the lowest per cents. of free carbon, and possibly those having low specific gravities and viscosities. These tests indicate that such tars do not greatly retard swelling.

Furthermore, the tests indicate that increasing the absorption of oil above 10 pounds per cubic foot does not tend to appreciably decrease swelling. It would seem, therefore, that in drawing up specifications for treating blocks, the waterproofing effect of the oil or treatment should not receive much consideration. The main points to be considered (aside from the selection of wood) should be to have sufficient oil of good grade to obtain a thorough penetration in order to avoid decay, and to specify a method of treatment that will not cause the blocks to bleed. The tests also indicate that swelling should be controlled principally by having the blocks in the green condition when laid in the street, and by taking special care with the filler and method of laying so that water will not penetrate to the bottom of the blocks.

APPENDIX.

Analysis of Creosote Used in Bleeding and Swelling Tests.

Sp. Gr. at 60°—1.071.

The distillation was as follows:

Temp. °C.	Per cent. Distillation.
205	1.2
235	22.7
245	5.7
275	9.9
305	11.5
360	27.6
Residue	20.9
Loss	0.5
Total	100.0

The distillation was carried on as described in Forest Service Circular No 112, using the "Hempel" column. The residue was a soft sticky pitch and indicated the presence of undistilled tar, probably less than 5 per cent.

Analysis of Tar and Creosote Mixture Used in Bleeding Test.

Specific Gravity of Tar at 60° C.—1.184
" " " Creosote " 60° C.—1.071
" " " Mixture " 60° C.—1.127

Free Carbon, 3%.
Distillation (Hempel column).

Temp. °C.	Per cent. Distillation.
205	1.6
235	15.4
245	1.3
275	6.1
305	8.2
330	10.1
Residue	56.8
Loss	0.5
Total	100.0

Viscosity at 160° F.—1.6 (Engler).

SPECIFIC GRAVITIES OF MIXTURES OF CREOSOTE AND CARBON-FREE TARS USED IN SWELLING TESTS.

Creosote % of total oil. lg. volume	Tar % of total oil lg. volume	Sp. Gr. at* 60° C.
Creosote and Tar of Specific Gravity 1.184.		
100	0	1.071
75	25	1.102
50	50	1.127
25	75	1.150
0	100	1.182
Creosote and Tar of Specific Gravity 1.232.		
100	0	1.071
75	25	1.105
50	50	1.132
25	75	1.163
0	100	1.215
Creosote and Tar of Specific Gravity 1.273.		
100	0	1.071
75	25	1.097
50	50	1.127
25	75	1.148
0	100	1.179

*Note.—The specific gravities given are those of the tars and mixtures after free carbon has been removed.

SPECIFIC GRAVITIES AND CARBON CONTENTS OF THE 50% CREOSOTE AND TAR MIXTURES USED IN SWELLING TESTS.

Tar used in Mixture	Test No.	Sp. Gr. of Mixture	% Free Carbon in the Tar	% Free Carbon in Mixture
By-product Tar Specific Gravity 1.184	1	1.127	6	Trace
	2	1.129	6	1.5
	3	1.132	6	3.0
By-product Tar Specific Gravity 1.232	1	1.132	16	Trace
	2	1.140	16	3
	3	1.147	16	5
	4	1.159	16	8
Gas House Tar Specific Gravity 1.273	1	1.127	30	Trace
	2	1.133	30	4.5
	3	1.146	30	8.0
	4	1.152	30	12.0
	5	1.166	30	15.0

MR. L. E. HESS: I have prepared a paper on this subject which I would like to present here.

CHAIRMAN CRAWFORD: If it is not very long we would be glad to have you read it. If you will take too much time I am afraid I will have to ask you to abstract it, if you can.

MR. L. E. HESS: It is of such importance that I think the time feature should be very lightly considered.

CHAIRMAN CRAWFORD: Just come forward and read it.

DISCUSSION ON BLEEDING AND SWELLING OF WOOD BLOCK PAVEMENT.*

By L. E. Hess.

The creosoted wood paving block industry is a very large and important one. Its success bears such an intimate relation to the affairs of our daily life that papers written upon it, especially from sources accepted as authoritative, should not be given to the public until the conclusions set forth therein are definitely established as correct.

I read extracts in the engineering papers from Mr. Teesdale's paper presented at the Municipal Convention in Boston last October and which has again just been read here. Extracts from the paper appearing in the engineering journals, and the publicity which will be given to it because of its presentation here, in my opinion, cannot fail to have a damaging effect on the creosoted wood block industry if allowed to stand uncorrected, because the writer, if I understand him correctly, advocates the very process of treatment now in use, for the process which he recommends as the best is the process now generally used, and because he advocates, impliedly at least, the continued use of the tar mixture which has caused the very defects it is sought to correct. The damaging effect will be that many who read his paper may accept his suggestions as means of remedying these evils.

In the first paragraph of the paper referred to the writer says "numerous theories have been advanced to account for the bleeding and swelling of paving blocks, but that in many cases they were unsupported by facts and did not give rise to methods that prevented the trouble." With a paper so prefaced one might expect that some solution would be offered. But he offers none. The results obtained and presented here and the methods employed in getting them cannot be considered as presenting any solution of the acknowledged defects. The bleeding of blocks is a recent evil. It has not been co-existent with the industry.

The origin of the bleeding of creosoted blocks is definitely located.

(*) Revised and rewritten by author. Received too late for reading and approval of Executive Committee.

It was at the time when creosote oil was first adulterated with coke oven-tar (this particular tar being chosen because of its low carbon content), and by implication at least the continued use of this destructive element is advised by him. Creosoted paving blocks were laid for 13 years prior to the introduction of creosote oil adulterated with tar without there having been a complaint on account of bleeding. This adulterated mixture was introduced largely in 1909. It possibly was introduced in a small way in 1908. But it became a factor in the industry in 1909. From that time until the present the use of the adulterant has been continued. In the city of Chicago creosoted block pavements were introduced in 1899; they were continued in use until 1909 without any complaint from bleeding. In 1909, and until 1912, bleeding prevailed with very destructive and expensive results.

It is a simple deduction that the way to correct the bleeding of blocks is to do away with the adulterant which caused it and the continued use of which has continued the bleeding. There is not occasion for attaching mystery to the defect, or of veiling the cause of it, or of viewing it as an unsolved problem requiring chemical research to cure it.

Based upon his laboratory tests, he believes the "mat" which rests on the surface of the paving blocks, after they are treated with a mixture of tar and creosote oil, is of value. This "mat" is the heavy pitchy substance of tar which, because of its density and pitchy character, does not enter, and cannot enter, the pores of the wood. He subjected these blocks to a temperature of 120° F. The temperature and other conditions seemingly were not sufficient to remove the "mat"—probably was low enough to have a drying effect upon the particular pitchy substance.

As an illustration, an untreated block (having no interior treatment whatever), if coated with tar or pitch, would have a "mat" and would have, under such a method of test, a high efficiency so far as waterproofing was concerned, and yet no block would be more unscientifically made and of as little value as a wood paving block. (Blocks similarly coated with linseed oil paint, or white lead paint, would show under such a test a high efficiency as to waterproofing, yet no one would say that such waterproofing would indicate the proper treatment for a paving block.)

It is manifestly unsound to make absorption and expansion tests upon a block so treated, and which is so fully protected against all conditions to which paving blocks are exposed, and make any deductions therefrom applicable to the wood paving block industry.

For instance, what would become of the "mat" under traffic? The first traffic, whether it was foot, wagon or automobile, would remove it. The same "mat" which became dry in an oven would become very sticky and plastic when exposed to and heated by the summer sun's rays. The "mat" would be carried away on every vehicle and every foot

that traversed it and, it would, therefore, act as no retardant or seal to the softer and more susceptible tarry mixture which rests immediately under the surface of the wood blocks or to the volatilization of the light oil within the blocks. The "mat" softens, becomes sticky and is removed, the tar mixture immediately under the surface of the blocks "bleeds" and the light volatile oils within the blocks are drawn to the surface and carry with them the tarry mixture.

These actions of the tar mixture have been characterized as "bleeding" and clearly prove its unsuitability as a wood preservative. It is equivalent to using in the treatment of the blocks a certain percentage of material which it is known will be immediately removed from the blocks, and each successive bleeding means the removal from the blocks more of the material with which the blocks were treated. The "mat," as it is called, is not, and cannot be, a fixed coating to a pavement, because it has neither the power of resisting the wear of traffic nor climatic influences.

The blocks now causing severe complaint, and which it is sought to remedy, are treated with the same material that produces the "mat" originally and, because it is so defective, we are trying to and must correct it by the substitution of a more suitable material.

The theory advanced for the correction of swelling is that green timber be used in the manufacture of blocks. Green timber means lumber containing a large per cent. of moisture, and, as a result, it is in an expanded condition. Taking as his thesis the tests of blocks made from green lumber, the blocks being already in an expanded condition, the writer of the paper claims green blocks will not expand as much as blocks cut from dry timber.

Let us analyze this statement as applied to wood paving blocks (although the same analysis could be applied to lumber generally), for the contention is made in connection with correcting the defect of the swelling of creosoted wood block pavements. If the question were asked: Will green lumber become dry on exposure to the atmosphere —to the sun's rays? The answer would be, Yes. A green paving block so exposed will become dry. I have seen blocks laid in a green condition, and I have seen them during the dry summer weather become so dry, and contracted to such an extent, that they were so loose they could be lifted from the street by the hands. These were examples and proof of maximum "greenness."

When blocks become loose in a street in this manner (and all moist or green blocks do become loose after exposure to the sun's rays), what happens to the pavement? The joints become filled with sand, fine dust and filth. If filled with sand or dust, such as is usual on streets, the joints are filled with a non-compressible mass, and the blocks are thus permanently separated from each other, but are still confined in the same length and width of space as when they were in their

original expanded condition; so, while they are in their contracted condition, there is additional matter put in to occupy part of their original space. A rain comes, the water enters the blocks to the same degree as before their contracted condition and they expand. The blocks on expanding return to their original condition of expansion, but the space they left vacant is now occupied by the non-compressible mass. What happens? Confined by rigid curbs the blocks on expanding must go upward, and this is characterized as the swelling. The green timber theory, therefore, does not solve the problem; on the contrary, it is conducive to swelling.

The theories advanced for the use of green timber and the use of a tar mixture with a resulting "mat" can only be very harmful to the wood block industry.

A wood block can be so treated that it will neither bleed nor swell. Manufactured in large quantities the expansion of the blocks can be so controlled that it will not be appreciable in the contour of the pavement nor in the curb line. But it must be controlled by properly treating and protecting the fibers of the wood, not by placing a coating or film over the pores. If the fibers are untreated, or treated with a light volatile oil which will evaporate from them, or treated with a viscous substance which will not evenly or thoroughly penetrate them (which, of course, means some fibers untreated), the fibers will not be protected against water, and expansion and contraction to an injurious degree will follow. When inferior or volatile oil is used, or when a tar mixture is used, the defects are always present and, on the provocations to which a street pavement is subjected, always recurring, because the inferior oil volatilizes and the tar mixture in a substantial degree not only volatilizes but is so susceptible to heat and atmospheric influences that in addition it undergoes chemical changes which renders it less fit for wood block paving purposes.

It might be asked, and the question has been asked many times, will not such a pavement ever reach its maximum expansion—the extent of the question being that perhaps at some time the pavement would expand so far that it would not expand farther. But the expansion quality is always present, so long as blocks are treated with a material that will permit of expansion at any time, because contraction will always succeed expansion, which again will be followed by expansion, etc.

The correction of the swelling and of the bleeding can be secured by the use of a stable preservative oil—an oil that is scientifically suited to the purpose of wood block paving; i. e., one that is unchangeable chemically and non-volatile and that penetrates and permanently adheres to the fibers of the wood. If such an oil is used and proper treatment is given the blocks, the fibers are permanently waterproofed and swelling will not occur, and because of its penetrative and adhesive

character, and its low coefficiency of expansion, it will not exude by capillary attraction or by expansion from heat.

The use of an oil of this character is the aim of those who realize the great importance of the wood block pavement and of the necessity of correcting the two defects which have proved such a serious setback to its general use.

MR. A. E. LARKIN: Is Mr. Teesdale's paper still under consideration?

CHAIRMAN CRAWFORD: Yes. Mr. Dutton has presented also a written discussion on Mr. Teesdale's paper, and I am going to ask the Secretary to read that paper now.

Secretary Angier then read the discussion as follows:

DISCUSSION ON THE BLEEDING AND SWELLING OF PAVING BLOCKS.

By E. R. Dutton.

I am sure that we have all been very much interested in the excellent paper that has just been presented by Mr. Teesdale on the "Bleeding and Swelling of Paving Blocks." All of us engineers, manufacturers and consumers of creosoted wood paving blocks are greatly indebted to the gentlemen of the Forest Products Laboratory at Madison, Wis., for their efforts in the investigation to better the creosoted wood paving blocks. They have made numerous experiments and have investigated the different conditions which make a better creosoted wood block paving, and their results have been especially helpful to us and we owe a vote of thanks to them for their work.

In this paper as presented today two defects of creosoted wood block paving are under investigation.

The bleeding of creosoted wood block paving has been criticized to quite an extent, and different causes have been assigned for this bleeding and particularly the quality of the oil has been blamed for this bleeding. From these experiments of Mr. Teesdale the quality of the oil has very little, if anything, to do with the bleeding of the blocks, and if anything, the tar and creosote mixture has less bleeding than the creosote oil. The principal cause of the bleeding lies in the treatment of the blocks, and if the treatment was carried on properly the bleeding would be reduced to a minimum, or removed almost entirely, provided an excess quantity of oil was not used in the treatment. I had the same opinion of the cause of bleeding some two or three years ago. After an investigation of the methods of treatment used in the different plants and the results on the streets of the materials used from the different plants, I came to the conclusion that the cause of bleeding was due almost entirely to the treatment. There has been a

tendency among cities and engineers to use an excess amount of oil in the treatment of their blocks, and this has much to do with the bleeding.

In regard to the swelling of the blocks and the bulging: The tests and the conclusions as presented seem to show that the same trouble applies principally to the swelling of the blocks, and that if a green timber is used and the proper treatment is applied, the swelling of the blocks is materially reduced, but there will always be a swelling of the blocks.

If the engineers and contractors in laying the blocks would consider the fact that there is to be swelling and provide an expansion space to take care of this swelling, there would be very little difficulty in the final rupture of the pavement.

We have had very little difficulty with either bleeding or swelling in our creosoted wood blocks laid in Minneapolis. I notice in looking over our pavements from time to time that we have a swelling of the blocks. This is particularly noticeable on the sides of the streets or in places where travel does not affect the place very much, where the bituminous filler in the joints of the blocks has been squeezed out perhaps ⅛ inch or so and showing the shape of the block distinctly by these ridges of the filler. This shows conclusively to my mind that swelling has taken place and has been overcome by the bituminous filler in the joints. And another thing, there must be a sufficient joint space left in the laying of the pavement to provide for this swelling and filler.

There is another feature that he has brought out in the experiments, and that is the blocks absorbing water from the under side and causing swelling, as in the sand-cushion experiments. We have had some difficulty of that character where there has been some break or a leak in a water-main connection, allowing the water to get to the under side of the blocks. In the summer this is not a serious matter, as no bulging is caused, but later in the season, when it is freezing, we are liable to have trouble. Under these conditions we have had several bad results, as the water absorbed by the blocks on the under side is frozen, so that we have a bulging of the blocks similar to the conditions which he found.

As far as the bleeding and the swelling of the blocks is concerned there does not seem, from our experience and from tests made by other people, to be anything gained in the use of a distillate creosote oil, and I cannot see what advantage it is to pay a much higher price for a distillate oil where the results are no better than a tar creosote mixture.

MR. CLYDE H. TEESDALE: I do not like to leave the impression that the quality of the oil has nothing to do with bleeding. In these experiments we found, in some cases, that the tar and creosote mixture bled more than the creosote and with other treatments the creosote bled the most. The relative amount of bleeding obtained with the different oils depends upon the method of treatment given.

MR. A. E. LARKIN: Mr. President, we must take direct issue with this opinion expressed by Mr. Dutton. We have furnished a large amount of material for his use up there in that territory, and I am pretty sure that after he has had a further chance to consider the matter carefully he will probably revise his opinion. It is true that under the mixed-oil specifications of Minneapolis Mr. Dutton has had comparatively little trouble with bleeding of blocks. I think that one of the very important reasons he has not had difficulty is because of the particular kind of material that has been available for use in that section. I do not believe that it is a typical example of material that might be applied on a mixed-oil specification in other territories. The whole trouble with bleeding blocks, as has been shown in the last several years at these meetings, has come about through the use of adulterated oil and that has been proven conclusively in a great many cases. There is no doubt that up to 1909 in Chicago the bleeding of blocks was certainly not objectionable. In fact, no one ever heard of it. There was no objection to creosoted pavement because of the bleeding of blocks. In 1909 tar was added to creosote oil used for treatment of paving blocks in Chicago, and from that time on until they got away from that same adulteration they had a whole lot of trouble. It even got so bad as to mean if the remedy was not secured we might just as well stop trying to put creosoted blocks in the City of Chicago. They have eliminated the difficulty now by the use of the distillate oil. Here is one proof on a very large commercial scale that the difficulty from swelling and bleeding has been a direct result of the mixture of creosote and tar, and while Mr. Dutton's discussion seems to show that the mixture of tar and creosote is no better than pure oil when properly injected into material, yet the facts surely point to the contrary.

CHAIRMAN CRAWFORD: We are glad to have these expressions and differences of opinion. Is there anything further on this paper?

MR. EDW. F. PADDOCK: Mr. Chairman, I think that, as a supplement to Mr. Teesdale's paper, I might make a few remarks concerning some tests that I have made with light treatments, that is, light absorption for paving blocks, experiments very similar to those described by Mr. Teesdale.

In my expansion tests I found that the expansion along the long dimension of the block, the 8-inch dimension, was considerably greater

than it was on either of the other dimensions and that the expansion in height was almost negligible. These blocks were treated with 3½ pounds per cubic foot of Avenarius Carbolinium and not the ordinary creosote such as Mr. Teesdale used. I found that the expansion after 204 days immersion in water amounted on the treated blocks to only a little over 0.25 per cent., that is, the maximum expansion along the long dimension of the block and on the blocks untreated it was something over 0.4 per cent. The greater part of this expansion occurred in the first 50 days, but I kept the blocks immersed for 204 days, in order to be absolutely sure that no further expansion was going to take place. The blocks were afterward taken from the water and exposed to the air under ordinary conditions and dried very rapidly, shrinking finally to a dimension much smaller than the original untreated dimension.

It is intended to go on with these tests and find out if these blocks have received a permanent set, and by re-immersing them in water whether they will go back to the place they were originally, that is, with the first immersion in water whether they received a permanent set. The greatest expansion we found on our treated blocks was 0.25 per cent., which, when figured over a 40-foot street, would amount in the aggregate to only about 1½ inches. This is not allowing for the spaces between the blocks taking up any expansion. There is one other thing that I might suggest regarding the expansion of blocks under heat, and that is the shrinking of blocks under heat. I know of one case in particular where treated blocks were used under exceptional conditions indoors. It was in the vulcanizing room of a rubber factory. The blocks were treated in the green state, and when I was there about a month after they were laid they were driving in wedges to keep them solid enough for the men to walk over them. You could put your hand in between the rows of blocks. This was an exceptional condition, and one that we do not very often find, but it is a thing that should be taken into consideration in placing blocks indoors where they are not exposed to weather conditions. In such cases the blocks should be kiln dried before they are treated.

MR. CLYDE H. TEESDALE: What are your specific questions that you wanted me to answer?

MR. EDW. F. PADDOCK: In regard to the variation in the swelling of the different dimensions, I found that they swelled about twice as much along the 8-inch dimension as they did along the 3-inch dimensions transversely, and that the longitudinal swelling was only about 1/12 of that along the 8-inch dimension. This proportion was true both in the untreated and in the treated blocks.

MR. CLYDE H. TEESDALE: The longitudinal swelling is practically negligible and does not enter into the question. We did not

make any measurements of the longitudinal swelling of the blocks. There is a difference between radical and tangenital swelling. I cannot state just how much that difference is.

MR. A. E. LARKIN: I would like to say that in my estimation the advent of bleeding, while it came about at the same time that the use of the mixture of coal-tar with creosote oil was started, that there was also at that time a change in the methods of manufacture as I can personally testify to. Greater care was used in treating and careful study developed new methods to obtain more satisfactory results even with the same materials cut. A great deal of the pavement in Chicago which has bled was treated according to the Forest Products Laboratory methods without preliminary vacuum and treatment, and those pavements did bleed very badly.

CHAIRMAN CRAWFORD: I hate to close the remarks on Mr. Teesdale's paper, but we will have to do so at once unless Mr. Teesdale has something he would like to say further.

MR. CLYDE H. TEESDALE: No.

CHAIRMAN CRAWFORD: We will have to go into Business Session, but just as we do I am going to ask the Chairman of the Auditing Committee to present his report.

(President Rex then took the Chair.)

MR. W. F. GOLTRA: I desire to present the following report of the Auditing Committee:

REPORT OF COMMITTEE ON AUDITING.

We, the Committee appointed to examine the accounts of the Secretary-Treasurer of the American Wood Preservers' Association for the year 1914, beg leave to report that we have examined and checked the receipts and expenditures and find that the accounts as reported by Secretary-Treasurer Angier are correct.

W. F. GOLTRA,
C. F. FORD.

THE PRESIDENT: What action does the Association wish to take on the report of the Auditing Committee?

MR. RICKER VAN METRE: I move that it be accepted.

MR. L. B. MOSES: I second the motion.

On the motion being put by the President it was declared carried.

THE PRESIDENT: Gentlemen, we will now go into the Business Session.

BUSINESS SESSION.

THE PRESIDENT: Will the Committee on Constitution and By-Laws come forward and submit their report at this time? We will

now hear the report of the Constitution and By-Laws Committee.

Mr. A. E. Larkin then presented the report as follows:

REPORT OF COMMITTEE ON CONSTITUTION AND BY-LAWS.*

To the Members of the American Wood Preservers' Association:

This report contains recommendations relative to the change in the Constitution and By-Laws, considered by Committee No. 6, at their meeting at the Auditorium Hotel, Chicago, Friday morning, Nov. 20, 1914.

Article I.

No change.

Article II.

Section 1.—The Association shall consist of Corporate, Associate. Junior and Honorary members.

Section 2.—A Corporate member shall be either an Executive or Administrative officer, or one directly connected with the operation of a wood-preserving plant or Forestry Bureau, including Plant Superintendents, Assistant Plant Superintendents, Treating Foremen and Plant Chemists.

Men in the following positions will also be eligible for Corporate membership: City Engineers, Professors and Instructors in Institutions of Learning, Railroad, Consulting, Forestry, County, Highway. Contracting and Inspecting Engineers, Engineers of Tests and City Chemists.

Section 3.—An Associate member shall be any person interested in the sale of material or equipment used in the wood-preserving industry.

Section 4 (new).—A Junior member shall be any person who may not qualify as a Corporate or Associate member.

Section 4 (old). New Section 5.—No change.

Section 5. New Section 6.—No change.

Section 6 (old). New Section 7.—Associate and Junior members shall enjoy all the privileges of the Association except they shall not be entitled to vote or hold office.

Section 7 (old). New Section 8.—Honorary members shall be entitled to all the privileges of a Corporate member.

Article III.

No change.

Article IV.

Section 1.—The entrance fees, payable on admission to the Association, shall be as follows: Corporate members, $10.00; Associate members, $15.00; Junior members, $5.00.

*The Constitution and By-Laws in full will be found in the first part of the Proceedings.

Section 2.—The annual dues payable by members whether Corporate or Associate shall be $10.00. Junior members shall pay annual dues of $3.00, the initiation fee to cover the first year's dues.

Section 3.—No change.

Section 4.—No change.

Section 5.—Any person whose dues are in arrears more than three months shall be notified by the Secretary-Treasurer, and until same are paid his privilege of membership shall be in abeyance. Should his dues become one year in arrears, his membership in the Association shall be cancelled, and the Proceedings shall be withheld until dues are paid to date.

Article V.

Section 1.—The officers of the Association shall be a President, three Vice-Presidents, a Secretary-Treasurer, and six other members, to be elected to make up an Executive Committee of eleven; this Committee to have entire jurisdiction over the affairs of the Association, to appoint the committees, to have entire responsibility for the government of the Association, and to pass upon the eligibility of proposed members, to arrange programs for future meetings, to select subjects for discussion, and to have full power in all matters not otherwise provided for.

Section 2.—No change.

Section 3.—The term of the President, Vice-Presidents and Secretary-Treasurer shall begin at the close of the annual meeting at which such officers are elected, and shall continue for a term of one year. Six (6) other members constituting the Executive Committee shall be elected for terms of three (3) years, two members being elected each year. Five members of the Executive Committee shall constitute a quorum.

Section 4.—No change.

Section 5.—No change.

Section 6.—No change.

Article VI.

No change.

Article VII.

No change.

Article VIII.

No change.

Article IX.

Section 1.—No change.

Section 2.—No change.

Section 3.—In order to conserve the papers read and discussed at the annual meetings of the Association, the same shall be published in book form, known as the Annual Proceedings, to be distributed free

among members of the Association, and to outsiders the cost shall be fixed by the Executive Committee.

Article X.

No change.

A. E. LARKIN, *Chairman.*
V. K. HENDRICKS,
G. B. SHIPLEY,
A. L. KUEHN,
W. W. DRINKER.
Committee.

MR. A. E. LARKIN: I would suggest that we vote on the various articles and sections separately.

MR. H. M. ROLLINS: I move that we vote on the report of the Committee on Constitution and By-Laws by sections.

MR. E. A. STERLING: I second the motion.

THE PRESIDENT: You have heard the motion. Are there any remarks? If not, all those in favor of the motion will please signify it by saying Aye, opposed No. The motion is carried.

Mr. Larkin then read Section 1, of Article II, as follows:

> The Association shall consist of Corporate, Associate, Junior and Honorary members.

MR. A. E. LARKIN: This you will note introduces for the first time our Junior membership.

THE PRESIDENT: Let us have the comments to be made on this article as rapidly as possible. If no one wishes to comment we will consider a motion to accept or reject the section.

MR. V. K. HENDRICKS: I move the section be accepted.

MR. AUGUST MEYER: I second the motion.

THE PRESIDENT: You have heard the motion. Are there any remarks? If not, all in favor of the motion will signify it by saying Aye, opposed No. The motion is carried.

MR. A. E. LARKIN: I will now read Section 2, Article II. You will notice we have tried to make the work of the Executive Committee a little easier by classifying the membership.

> A Corporate member shall be either an Executive or Administrative officer, or one directly connected with the operation of a wood-preserving plant or Forestry Bureau, including Treating Foremen, Plant Superintendents, Assistant Plant Superintendents and Plant Chemists.
>
> Men in the following positions will also be eligible for Corporate membership: City Engineers, Professors and Instructors in Institutions of Learning, Railroad, Consulting, Forestry, County, Highway, Contracting and Inspecting Engineers, Engineers of Tests and City Chemists.

MR. C. M. TAYLOR: I would like to suggest that Plant Superintendents be put ahead of Treating Foremen.

THE PRESIDENT: The Committee will accept that suggestion. Are there any more comments on that?

MR. CHAS. C. SCHNATTERBECK: Mr. Chairman, in Article II, Section 2, the definition of a Corporate Member as given by the Committee has been slightly changed in the suggestion that I will make:

> A Corporate member shall be either an Administrative or Executive officer, or anyone directly connected with the operation of a wood-preserving plant or Forestry Bureau, or anyone whose professional occupation is directly connected with the wood-preserving industry. Corporate membership shall not be issued in the name of a firm or co-partnership.

That last clause is a protection against any combination which may be formed to offset the purposes of the Association.

By that I mean if you admit a co-partnership as a member to the Association that co-partnership would be privileged to change its member every year and it may be possible in that way to eliminate the initiation fee. Now from a business standpoint it would seem possible—and I should say advisable—to have every man turn in his initiation fee at the time he submits himself for membership, whether he is a member of a firm or a co-partnership, and let everyone stand on his own merits.

THE PRESIDENT: While the Committee is looking over this article in the light of the suggestion made, are there any other comments on this?

MR. H. M. ROLLINS: Will you kindly have that re-read?

THE PRESIDENT: Mr. Larkin, will you re-read this article?

MR. A. E. LARKIN: I might say before I re-read this article that this is a point that the Committee considered and we thought it was opening the doors too wide and as far as the Committee is concerned we would rather have our recommendation stand as shown in Section 2 of Article II, as follows:

(Mr. Larkin then re-read the section.)

MR. W. W. LAWSON: I move the adoption of that section.

MR. C. M. TAYLOR: I second the motion.

THE PRESIDENT: You made this as a suggestion, did you not, Mr. Schnatterbeck?

MR. CHAS. C. SCHNATTERBECK: Yes, for the better policy of the Association. I understand, though, it would be advisable to withdraw the suggestion I made. This may be premature, but I withdraw it in any event.

THE PRESIDENT: The motion before the house has been seconded, and we will now vote on the adoption of the section as re-

ported by the Committee. All in favor of the motion will signify it by saying Aye, contrary No. The motion is carried.

Mr. Larkin then read Section 3 of Article II, as follows:

> An Associate member shall be any person interested in the sale of material or equipment used in the wood-preserving industry.

THE PRESIDENT: Any comments on this paragraph?

MR. EDW. F. PADDOCK: Mr. President, I suggest there that an Associate member shall be any person interested in the sale of material or equipment; I would suggest the insertion of the word "solely" or "exclusively," because in many cases, in fact, the two industries are combined both in the selling and operating of the plant and in those cases there would be a conflict of opinion. If the word "exclusively" were inserted there it would clear up any difficulty that might arise.

MR. A. E. LARKIN: We do not agree with you at all in this, especially as it would be very difficult to separate into a new class men who are furnishing equipment for the wood-preserving industry and men who are furnishing equipment to the wood-preserving and other industries as well. I would rather not make any further qualifications of Section 3.

THE PRESIDENT: What is the pleasure of the Association in this matter?

MR. H. J. VON LEER: I move that it be accepted as read.

MR. WM. TOWNSLEY: I second the motion.

THE PRESIDENT: All in favor of that motion will signify it by saying Aye, contrary No. The motion is carried.

Mr. Larkin then read Section 4 as follows:

> A Junior member shall be any person who may not qualify as a Corporate or Associate member.

THE PRESIDENT: Have you any comments on this section? I am delighted to see this suggestion come before our Association at this time, because it means the younger men in the industry and our schools are going to take more of an interest in the work of the Association. We are going to get a better class of men interested early in life in this business.

MR. J. A. JOHNSON: I move the section be adopted as read.

MR. AUGUST MEYER: I second the motion.

MR. S. R. CHURCH: Is it the intention to put any age limit on the Junior membership?

MR. A. E. LARKIN: There has been considerable discussion in regard to that matter, and we should be very glad to hear from members who have had experience in other associations and to know if an age limit is to be put on what the age limit will be. It seems as

though there should be some further qualifications, but we are not so sure about it.

MR. H. J. VON LEER: I do not believe that we should set an age limit. Such a limit might exclude a few university students and other desirable men whom we need and should welcome in our Association. This matter may well be left to some committee to decide, and the applicants admitted according to their respective merits.

THE PRESIDENT: It seems to me like Mr. Von Leer's suggestion is an excellent one, and I would suppose that the Executive Committee running this Association ought to be capable of passing on that point. I think it would be an excellent point to leave to the Executive Committee, because I believe any Executive Committee we have will be thoroughly capable of handling that point.

MR. S. R. CHURCH: My idea was not to put a minimum age limit, but a maximum, so that a man could not be a Junior member all his life, but I think the Executive Committee can handle that matter very well.

THE PRESIDENT: You will withdraw your suggestion then, Mr. Church?

MR. S. R. CHURCH: Yes.

THE PRESIDENT: You have heard the motion to adopt the section. All those in favor of the motion say Aye, opposed No. The motion is carried.

Mr. Larkin then read Section 7 as follows:

> Associate and Junior members shall enjoy all the privileges of the Association except they shall not be entitled to vote or hold office.

THE PRESIDENT: What is the pleasure of the Association? Any remarks on this section?

MR. C. W. TIFFANY: I move its adoption.

THE PRESIDENT: Mr. Tiffany moves the adoption of this section. Are there any remarks?

MR. H. M. ROLLINS: I second the motion.

THE PRESIDENT: Any remarks on the motion? If not, we will vote. All in favor of the motion will say Aye, contrary No. The motion is carried.

Mr. Larkin then read Section 8.

> Honorary members shall be entitled to all the privileges of a Corporate member.

MR. A. E. LARKIN: The Committee deliberated over this to some extent and they thought a great many Honorary members might be appointed as such by the members of the Association in time to come who would probably be the very best men that we could get to serve on our committees or as officers.

THE PRESIDENT: Any remarks on this?

MR. WM. J. TOWNSLEY: I move its adoption.

MR. A. C. HAGEBOECK: I second the motion.

THE PRESIDENT: All those in favor of the motion will say Aye, opposed No. The motion is carried.

Mr. Larkin then read Section 1 of Article IV, as follows:

The entrance fees, payable on admission to the Association, shall be as follows: Corporate members, \$10.00, Associate members, \$15.00, Junior members, \$5.00.

THE PRESIDENT: The convention now has Section 1 of Article IV. What is the pleasure of the Association on this section as written by the Committee?

MR. S. R. CHURCH: I move its adoption.

MR. J. A. JOHNSON: I second the motion.

THE PRESIDENT: Are there any remarks?

MR. E. A. STERLING: Mr. President, it seems to me that this is a point which ought to be considered. Of course, we know that the Committee has done so, but particularly the matter of Associate membership ought to be considered. Is it not true that the \$25.00 look like a pretty big fee to many who occasionally come to our meetings and that our real aim is to get a continuous sustained income from our membership rather than to go pretty high on the Associate members in the beginning? I think we should at least consider it. I will not offer it as a resolution. I think we should consider the feasibility perhaps of including the first year's dues, perhaps making the initiation and the dues \$20.00 for the first year, or something of that kind.

THE PRESIDENT: This is really a very important point in our Association. Our revenue is our life blood. I think we can well afford to spend a few minutes in a thorough consideration of this in addition to the thorough study the Committee has given it. We would like to hear from any other member of the Association.

MR. G. A. LEMBCKE: During the past year I have been trying to induce some of my European friends to join this Association, and, as I understand it now, they would have to join as Associate members at the price of \$25.00. I do not think they would be inclined to join at that price, because \$25.00 in Europe looks like quite a bit of money. They probably would feel that they would not get \$25.00 worth of benefit from their membership. On the other hand, if we could reduce the fee to \$10.00 I think we could induce them to join and they would feel they were deriving some benefit so far at least as their membership is concerned. They would be inclined to send us reports, etc., and keep in close touch with the Association, and I think we might be able to get quite a number of foreign members.

THE PRESIDENT: When the Association considers that Mr. Lembcke has contributed five new members to the Association, I think his remarks come to us with weight. We hope that we will get some more discussion.

MR. E. A. STERLING: If it is in order—is there a motion before the house?

MR. S. R. CHURCH: I will withdraw my motion, Mr. President.

MR. E. A. STERLING: To bring this matter to a head, I will move, Mr. President, that the initiation fee of $15.00 for Associate membership be made to include the first year's dues.

MR. F. D. MATTOS: I second the motion.

MR. F. J. ANGIER: If that decision is made Associate members will be admitted for less than Corporate members. Corporate members now pay $10.00 for initiation and $10.00 dues. Associate members are required to pay $15.00 initiation and $10.00 dues.

MR. A. E. LARKIN: There is another thought that we should carefully consider, and that is that the men who are coming in as Associate members as a general rule are men who expect to get in close touch with the members of this industry with the idea of selling and furnishing material to them. It comes very close in some cases to being a promotional expense, and I think they can very well afford to pay the $25.00.

MR. WM. J. TOWNSLEY: Mr. President, I think Mr. Larkin struck the nail on the head in his last remark. An Associate member is a man interested in the sale of materials used in the wood-preserving industry. He is going to come across with $15.00 if he has anything of importance to sell to this Association. We need him and we also need his $15.00. He needs us.

THE PRESIDENT: Have you any other remarks on this subject? Of course, each one of us has his own ideas on this subject. You will pardon me for expressing mine. I think of all things we want to keep up our dues, because we have them every year. They are the things that support our Association. Personally, I would like to see the initiation fees of all of them reduced, but I certainly want to abide by the will of the majority. I would be very glad to have an expression on this subject.

MR. E. A. STERLING: I will withdraw my motion.

THE PRESIDENT: The motion has then been made and seconded that the Committee report on this Section 1 be adopted for our Constitution. All those in favor of that motion will signify it by saying Aye, opposed No. The motion is carried.

Mr. Larkin then read Section 2, Article IV, as follows:

> The annual dues payable by members, whether Corporate or Associate, shall be $10.00. Junior members shall pay annual dues of $3.00; the initiation fees to cover the first year's dues.

MR. W. W. LAWSON: That just applies to Junior membership.

THE PRESIDENT: Yes. One of the members suggested that we make this a comma after $3.00 instead of a semicolon. Any remarks on this section? If not, do I hear a motion to accept or reject it?

MR. A. R. JOYCE: I move the adoption of the section as read.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: All in favor of adopting this——

MR. W. W. LAWSON: Mr. President, there has been some question among the members whether or not the $3.00 was enough to cover the actual cost of carrying the membership on the books, and I think Mr. Angier could give us some information on that.

THE PRESIDENT: We would like to hear from Mr. Angier on that subject.

MR. F. J. ANGIER: I think a Junior member should pay an initiation fee of $5.00 in addition to annual dues. It costs the Association more than $3.00 a year to carry a member.

MR. A. E. LARKIN: The idea of the Committee in this was to increase the membership to a very large extent, and in that case there is no doubt that the Association will be able to carry the membership on the books for this charge. The idea is to enlist the rank and file. This has been President Rex's idea for a long time. It has been one of his pet ideas to get the rank and file of the men interested in this industry to line up with the Association. It has been done in other associations, and it can be done in this one.

THE MEMBERS: Question, question.

THE PRESIDENT: All in favor of adopting Section 2 of this article will signify it by saying Aye, opposed No. The motion is carried.

Mr. Larkin then read Section 5, Article IV, as follows:

> Any person whose dues are in arrears more than three months shall be notified by the Secretary-Treasurer and until same are paid his privilege of membership shall be in abeyance. Should his dues become one year in arrears, his membership in the Association shall be cancelled and the Proceedings shall be withheld until dues are paid to date.

MR. J. H. WATERMAN: I move the adoption of that section.

MR. F. D. MATTOS: I second the motion.

THE PRESIDENT: Mr. Waterman moves the adoption of Section 5, Article IV. Are there any remarks on the motion?

MR. E. T. HOWSON: Does the Committee provide for any method of reinstatement without the repayment of the initiation fee?

MR. A. E. LARKIN: No, there is no such provision made. The Secretary has had considerable difficulty in collecting the money outstanding in a good many cases and we thought we would just help him a little.

MR. E. T. HOWSON: I simply raised the question whether the provision made by the Committee is wise in that it requires that a man who might lapse for a year or two will have to pay a second initiation fee. It would seem unjust for him to have to pay this a second time.

MR. F. D. MATTOS: In that connection he would have to pay his arrears. I think it is just as much one way as the other.

THE PRESIDENT: By lapsing a year or two, as you suggest, Mr. Howson, he would simply be not paying his dues while still receiving the benefit of the Association for two years, and if he had to come in at the end of two years he had better pay a new initiation fee than the two years' dues. I think that is the usual procedure in all organizations both business and fraternal. It is with all the organizations that I happen to know anything about.

MR. J. H. WATERMAN: If he wants the Proceedings all he has got to do is to pay the price.

THE PRESIDENT: I would just like to make one suggestion that this matter is oftentimes something over which the man has no control. He might be dropped, and in that case it has always been the custom to leave this matter of settling the dues to the discretion of the Executive Committee, which I feel is a wise policy. If there are no further remarks we will ask for a vote on this question. All in favor of adopting Section 5 of Article IV as reported by the Committee will signify it by saying Aye, contrary No. The motion is carried and the section has been incorporated in our Constitution.

Mr. Larkin then read Section 1 of Article V as follows:

> The officers of the Association shall be a President, three Vice-Presidents, a Secretary-Treasurer, and five other membrs to be elected to make up an Executive Committee of ten; this Committee to have entire jurisdiction over the affairs of the Association and to appoint all committees, to have entire responsibility for the government of the Association, and to have power to pass upon the eligibility of proposed members, arrange programs for future meetings, select subjects for discussion, and to have full power to arrange all matters not otherwise provided for.

MR. E. A. STERLING: I think this is one of the weak points of the organization, weak to the extent that there is no provision made for continuity of at least some of the administrative officers of the Association. I think it is a matter which should be discussed, and if the right decision can be reached a motion passed which will provide for these additional men outside of the acting officers. Call them what you will, but retain some of them in office, and follow out a series so as to have some continuity to your organization.

THE PRESIDENT: As Mr. Sterling says, this is the most important article that we have for consideration, and when I first read the article as proposed by the Committee I rather objected to it, feeling that it was an unwieldy organization, but I am going to ask Mr. Kuehn to explain his viewpoint on this, which I think will elucidate the matter for all of us.

MR. A. L. KUEHN: Gentlemen, when I became a member of this Committee, the principal point that stood out to me was the criticism which I had heard of this Association continually through a number of years, even before I was a member of it, that there seemed to be no well-directed effort in its work. No doubt the thing that we must do to have an organization that is respected and whose work is recognized is well directed, well written, well edited, well conceived writings and papers and work of committees.

While there has been a lot of valuable work done I think we all recognize it has not been a concerted thing, a well-directed effort. Mr. Sterling hit the nail on the head to my idea that we must have experienced men. I do not mean this as any criticism against the previous officers and certainly not against our present President, but we know in running our business we are glad to put men in charge who have had experience and in whom we have confidence. We are confronted with men to be elected who have been members of the Association. We know them, and we feel they are all right. But I say let us look at them two or three years.

The Association is important enough to have elected an experienced man as its head. A complaint I heard was that it is hard to get papers. The Program Committee complained they could not get their work done and the Program Committee is certainly the most important Committee that we have. In fact, it is this work that the Association will stand or fall by. Therefore, that should be in the hands of the strongest body that we can place at our head.

The Executive Committee as it has existed was too small. The work that is outlined for this Executive Committee is considerable and certainly the five men who are the officers of the organization cannot be asked to give the time necessary to make the work what it should be. They have done it, but I think it is asking too much of them. Therefore, my idea was that the Program Committee, which I think is the most important committee we have and on whose work we shall stand or fall, should be eliminated and the work of this Program Committee properly enlarged to become the work of the Executive Committee and the Executive Committee enlarged. The question arose whether ten members were not too many. Undoubtedly, as I see it, the Executive Committee will divide itself into two sub-committees, one for the business of the organization and the other for the technical or program part. Certainly, if you have any less than ten it will be very difficult

to get more than one at a meeting, and I think if you have two sub-committees of five or four, the President and Vice-President not being members of the sub-committees, if they so choose, why you ought to always get two or three. I think the business of running the Association, the business of getting cut the work which is printed, ought to be in the hands of the most powerful body that we can create.

THE PRESIDENT: The point that appealed to me in Mr. Kuehn's reasoning in this matter was that if this plan is adopted the President of your Association will designate immediately after election the members of this Executive Committee that will handle the literary part of the program of our Association work and the members to handle the business of the Association. The assignment will be made by the President. That is the point that appealed to me, and with that understanding I absolutely withdrew my objection to Section 1 of Article V.

MR. M. K. TRUMBULL: I agree with the previous speaker on this point. There are two additional points I would like to present. First at least two of these should be ex-Presidents and that the other three should represent districts covered by the membership of the Association.

MR. E. A. STERLING: One more word supplementing what Mr. Kuehn has said. Dr. von Schrenk last night pointed out to you all the open door, as it were. The Association is certainly facing at this time one of the greatest opportunities in its history. These opportunities are coming at a time when there is a general movement towards promotion, if you wish to call it such. The time is very ripe for getting busy on behalf of ourselves as wood-preservers and working with some of the bigger, broader interests in the lumber industry, so I think this Committee of five who will be the older and more experienced men should look after this matter of promoting the broad policies which have to be considered.

THE PRESIDENT: Are there any more remarks on this section?

MR. WM. J. TOWNSLEY: I would like to ask that this section be read now as altered.

(Section re-read).

MR. JOHN FOLEY: Mr. Chairman, in order to prevent a dead-lock in the Executive Committee, it has occurred to some of us that it should have eleven members instead of ten. And so as to have experienced members on that Committee, provision for overlapping their terms of office should be made. Therefore I propose that Section 1 read:

"The officers of the Association shall be a President, three Vice-Presidents, a Secretary-Treasurer, and six other members to be elected to make an Executive Committee of eleven; this committee to have entire jurisdic-

tion over the affairs of the Association, to appoint the committees, to have entire responsibility for the government of the Association, to pass upon the eligibility of proposed members, to arrange programs for meetings, to select subjects for discussion, and to have full power in all matters not otherwise provided for."

The provision for overlapping executive committeemen will be made in Section 3, which we can wait for, as you are considering the amendments section by section.

MR. J. H. WATERMAN: Mr. President, I would suggest that Mr. Foley confer with the Committee and see what part of his suggestion they can adopt or recommend.

THE PRESIDENT: Mr. Foley's suggestion in regard to Section 1, Article V, is that we elect six additional members instead of five, to make up the Executive Committee of eleven. Those two numbers will be changed, five will be changed to six and ten will be changed to eleven. The Committee is willing to accept that suggestion. A motion is now in order to accept or reject this section with that amendment.

MR. C. E. COBEAN: I move the adoption of this amendment.

MR. E. A. STERLING: I second the motion.

THE PRESIDENT: It has been moved and seconded that this section be adopted as amended.

MR. E. A. STERLING: Just a word on that and merely a suggestion. I think it would be very nice if it became an unwritten law that the outgoing President become one of the new members of this board of six, this not to be stated or written, but just an unwritten law of the Association.

THE PRESIDENT: In making this change it will necessitate a change in Section 3, in which there was no change recommended by the present Committee.

Upon the motion being put by the President, it was declared carried.

THE PRESIDENT: I will ask Mr. Foley to read his suggestion to the Committee in regard to Section 3.

MR. JOHN FOLEY read:

Sec. 3. The terms of the President, Vice-Presidents and Secretary-Treasurer shall begin at the close of the annual meeting at which such officers are elected and shall continue for a term of one year. The six other members constituting the Executive Committee shall be elected for terms of three years, two members being elected each year. Five members of the Executive Committee shall constitute a quorum.

To make the overlapping possible, it is necessary that the six first elected draw lots or otherwise agree on the pair to serve two years and the pair to serve one year, after which the retirement becomes automatic.

THE PRESIDENT: My understanding is that the Committee accepts the change.

MR. J. H. WATERMAN: I move the adoption of the section as read by Mr. Foley.

MR. C. P. WINSLOW: I second the motion.

THE PRESIDENT: It has been moved and seconded that we change Section 3 of Article V, as read by Mr. Foley and accepted by the Committee. All in favor of that motion will please say Aye, contrary No. The motion is carried.

Mr. Larkin then read Section 1, Article VII, as follows:

An annual meeting at which the officers for the coming year shall be elected and all annual reports read shall be held on the third Tuesday of January in each year at 10 o'clock A. M., at Chicago, Illinois.

MR. E. A. STERLING: Mr. President, I move to strike out the words "at Chicago." My grounds for making that suggestion are that the convention has always been able to handle the situation, and that conditions may arise when we will want to go elsewhere. Why should we tie our hands and be prevented from going somewhere else if we want to?

MR. S. R. CHURCH: I would like to go a little bit farther than Mr. Sterling has gone in that suggestion. I think that not only might there be an occasion when we would want to go elsewhere than Chicago, but that, while most of the meetings should be held in Chicago, we can definitely strengthen the Association by occasionally holding meetings in different sections of the country where the wood-preserving industry is concentrated. I feel that to hold such a meeting in the east would greatly strengthen the Association and would be of definite benefit to the treating men along the Atlantic Coast, many of whom are unable to attend meetings in Chicago. I believe the meeting in the south last year was a direct benefit along those lines.

THE PRESIDENT: Any other remarks on this section?

MR. H. H. GERHARD: The people in St. Louis have asked me to invite you to hold the next convention there.

THE PRESIDENT: Mr. Gerhard, the question of the meeting place for the next convention is not up now. It is simply the adoption of this motion, and we will be glad to hear that invitation later if you will kindly yield the floor.

MR. EDW. F. PADDOCK: Mr. President, it seems to me that the date of the convention might be revised, since as it stands it conflicts with the annual meeting of the American Society of Civil Engineers, and I know that there are a great many members of this Society who would like very much to attend this other meeting and that there are some who are attending that Society's convention who would like to attend this. Would it not be advisable to investigate the time of meetings of other technical societies and try to select a date that will not conflict with their meetings?

THE PRESIDENT: Do I hear a second to Mr. Sterling's motion?

MR. L. B. MOSES: I second the motion.

THE PRESIDENT: It has been moved and seconded that "at Chicago," in Section 1, Article VII, proposed by the Committee, be stricken out.

MR. WM. J. TOWNSLEY: Mr. Chairman, I think perhaps you overlooked the fact that no reference was made then to this indeterminate place at which the meeting shall be held nor the method by which it should be chosen. It would be well to make some reference to that.

THE PRESIDENT: We will vote on this motion of Mr. Sterling's as to whether we will strike out the words "Chicago, Illinois," from Section 1. All in favor of the motion will say Aye, contrary No. There seems to be a division, and I will call for a standing vote. All in favor of the motion to strike out this clause will kindly rise to their feet and the Secretary will count the votes.

SECRETARY ANGIER: Forty-seven.

THE PRESIDENT: All opposed to the motion will please rise. The motion has been carried that the words "Chicago, Illinois," be stricken from this section and replace it with the former reading of the Constitution, which I will ask Mr. Larkin to read.

MR. A. E. LARKIN: Section 1, of Article VII, in regard to the meeting place then will be as it is at present.

> An annual meeting at which the officers for the ensuing year shall be elected and all annual reports read shall be held on the third Tuesday of January in each year at 10 o'clock A. M., at such place as the Association, at the previous annual meeting, may designate.

MR. J. H. WATERMAN: I move its adoption as read.

THE PRESIDENT: Mr. Waterman, that is in the Constitution at present. The committee withdraws that proposed amendment. We will now proceed to read Section 3, Article IX.

Mr. Larkin then read as follows:

> In order to conserve the papers read and discussed at the annual meetings of the Association, the same shall be published in book form, known as the Annual Proceedings, to be distributed free among members of the Association, and to outsiders the cost shall be fixed by the Executive Committee.

THE PRESIDENT: Any remarks on Section 3, Article IX?

MR. H. J. VON LEER: I believe the present publications of our Society, *i. e.*, Annual Proceedings and Quarterly Bulletin, are not sufficient to cover the matter handled by the organization and advocate either enlargement of Bulletin or some new matter published by committee or members designated for such work.

MR. W. F. GOLTRA: It seems to me that Section 2, Article IX, conflicts with Sections 2 and 3, of Article I, if the word "exploit" in the former means the suppression of discussion of matters pertaining to wood-preservation. I would like to have someone explain the meaning of that word in connection with that section of our Constitution and By-Laws. These sections are inconsistent. How can this Association grow and develop unless we allow members to describe and unfold their methods, preservatives or apparatus pertaining to wood-preservation? Why should there be a ban placed upon any new idea or any new device and prevent discussion just because it may be patented or may be superior to some of the old-fogy notions and methods now prevailing. I would like to have someone interpret the meaning of the word "exploit" as used in that Section.

THE PRESIDENT: As I understand Section 2, Article I, it says that "the purpose of the Association shall be for the advancement of the wood-preserving industry," and then, in Article IX, Section 2, the idea is to prevent the exploiting of personal ideas that are patented and often take up the time of the Association for no gain except for the individual member. This sometimes may work a hardship, but I believe that every member here appreciates the fact that the Executive Committee which we elect is strong enough and has been strong enough in the past and will continue to be strong enough to handle the matter for the best interests of all.

MR. H. M. ROLLINS: Mr. President, it occurs to me that the point taken by Mr. Goltra is well taken. It has also occurred to me that this Association should make some provision—the Executive Committee is the proper body to handle that, of course—so that the Association as an association may get the benefit of new ideas, new devices and new methods. I do not mean by that that this Association should throw its doors open to every man who has an "axe to grind," but I do believe that as a progressive organization there should be some means by which all of these new ideas that come up can be brought before the members of the Association.

MR. WM. J. TOWNSLEY: Mr. President, as a rank outsider, a man who has a selfish motive in belonging to this Association aside from the pleasure he gets, a man who has something to sell, I may at times make statements on this floor that are not such as this Association as an organization and a body would care to stand for, something they would not care to have sent out by their authority. I am simply typical of many who may come to this body with similar axes, some of which have edges that are on both sides and that cut both ways. I think Mr. Rollins' point is well taken. I quite agree with Mr. Goltra. I also agree with the idea that the Executive Committee can determine what shall be put in the official Proceedings as published

annually and as read by men who do not come here. There is no reason why I may not bring a new idea, patented if you please, and offer it here, and why that recommendation should not be published in an appendix, so to speak, with the distinct statement that the Association assumes no responsibility. It does not advocate it or condemn it, simply presents the idea of the man who presented the idea to the Association, leaving it to those who care to investigate it to get such good as they can out of it. The Proceedings would offer a convenient way of passing along such information without putting any responsibility upon the Association at all.

MR. E. T. HOWSON: Has not this Association a medium through which those devices can be described and presented without giving them a place in the Proceedings? We have a Bulletin. Could not such information be incorporated in it?

MR. E. A. STERLING: I think we have got to play very safe on this proposition. It is not covered in this Article I, where it states: "Our object is to maintain a high business and professional standing?" The maintenance of that high standard is up to the Executive Committee, and they receive and use and consider and publish or not these various things, but we have got those fundamentals to maintain, and we have got an Executive Committee to do it, so I think we are safe in letting the Executive Committee handle it.

MR. WM. J. TOWNSLEY: Good.

THE PRESIDENT: We are somewhat divided on this subject. The quickest way to settle it harmoniously will be either for Mr. Goltra to make a motion which we can consider on the revision of Section 2, Article IX, or Mr. Townsley Do either one of you care to make a motion?

MR. W. F. GOLTRA: I make a motion that Section 2, Article IX, be revised at our next annual meeting. We cannot take it up at this time, because due notice has not been given.

THE PRESIDENT: Then if it is the pleasure of the Association we will refer Mr. Goltra's section back to the Committee on Constitution and By-Laws for consideration next year. Is that agreeable, Mr. Rollins?

MR. H. M. ROLLINS: Certainly.

THE PRESIDENT: Is that agreeable to you, Mr. Goltra?

MR. W. F. GOLTRA: Certainly.

MR. E. A. STERLING: Can we not vote on this motion?

THE PRESIDENT: Yes, we can vote on his motion. Do I hear a second to Mr. Goltra's motion?

MR. J. H. WATERMAN: I second the motion.

MR. H. M. ROLLINS: Mr. President, that is taken care of in the Constitution and By-Laws. Any amendment that is desired can be brought before the Association at the next meeting without voting on it at this time.

MR. E. A. STERLING: As to the feasibility of taking any action this has stood and has stood well.

THE PRESIDENT: We will now vote on this motion of Mr. Goltra. All in favor of recommending to the Committee on Constitution and By-Laws for revision next year Section 2, Article IX, please signify it by saying Aye, contrary No. The Chair is in doubt. All in favor of this motion will please rise to their feet and the Secretary will count the votes. Opposed, No. The motion is lost.

We will proceed now with the question before the house, which is Section 3. It has been moved and seconded that we accept this section. All in favor of accepting this section as presented by the Committee signify it by saying Aye, contrary No. The motion is carried.

MR. W. F. GOLTRA: Mr. President, you have not answered my question. I asked for an interpretation of the word "exploit" in Section 2, Article IX. In what sense is it used there? Does it mean "to unfold," "to explain," or does it mean "to make money under false pretense," or what does it mean? What is the object of the Association in carrying this section in our By-Laws? That is what I would like to know and have the explanation go into our records. I have my suspicions as to who drafted that section and their motives, and I believe it would redound to the welfare of this Association to have a clear understanding of this section or else eliminate it from our Constitution and By-Laws.

I have been told that this section of our By-Laws was adopted to prevent the presentation of any new ideas or inventions before the Association, and even goes so far as to prohibit the discussion of old ideas or inventions in the timber-treating industry and thus prevent the explication of certain questionable methods now employed by unscrupulous persons. Some of these spurious methods will not bear scrutiny, and the exploiters of those processes do not want the searchlight of investigation turned upon them. It is a technical artifice to prevent inquiry. We are associated together to promote true knowledge of the principles of timber treating and discussions will not be denied except by those who are slaves to prejudice or interested in the continuation of questionable practices. The cause of truth and justice can never be hurt by temperate and honest discussion, and that treating process which will not bear such a scrutiny must be systematically or practically bad. A good process of preservative cannot be endangered by discussion of its merits; for whether it be good or bad can never depend upon assertion; the question is to be decided by simple inspection.

This section of our Constitution should be annulled. Every member should have the right and privilege of presenting any new ideas of procedure or inventions in the treatment of timber.

MR. JOSEPH SMITH: What is the method of procedure, and who is competent to answer it?

THE PRESIDENT: This article has been in our Constitution for several years, and I would suggest that Mr. Goltra submit his question in writing to the Executive Committee in order to handle it. Would that be satisfactory, Mr. Goltra, to you?

MR. W. F. GOLTRA: Certainly.

THE PRESIDENT: That completes the work of the Committee on Constitution and By-Laws, and we thank them for this report.

MR. J. H. WATERMAN: Mr. Chairman, I want to ask a question. Ought we not make a motion to adopt the Constitution and By-Laws as a whole as amended?

THE PRESIDENT: I do not feel that we do.

MR. J. H. WATERMAN: All right. What you say goes.

THE PRESIDENT: We will now have the report of the Committee on Resolutions, Mr. Foley, Chairman. Mr. Foley will read the resolutions.

Mr. Foley then read the following resolutions, which were unanimously adopted by the members assembled in convention:

RESOLUTIONS ADOPTED.

No. 1.

WHEREAS, A Forest Products Federation of the various branches of the Lumber Industry is contemplated for the promotion of the use of wood for all purposes to which it is adapted; and,

WHEREAS, The preservative treatment of wood is an important factor in promoting its proper use in relation to service requirements;

Resolved, That the American Wood Preservers' Association indorse this movement and that it co-operate by sending representatives to the meeting which is to be held February 24 and 25, 1915, in Chicago.

No. 2.

WHEREAS, The need for an authoritative guide in matters pertaining to proper treatment of wood to prevent its deterioration is apparent;

Resolved, That the officers of the American Wood Preservers' Association, during 1915, make such arrangements as will result in definite steps toward the preparation of a "Manual on Wood-Preserving."

No. 3.

WHEREAS, There is a demand for an established record of Service Tests of woods treated by various processes; and,

WHEREAS, The basis for such a record is available;

Resolved, That the Executive Committee of the American Wood Preservers' Association appoint a standing Committee whose functions shall be to collect, assemble and provide an annual cumulative Record of Service Tests.

No. 4.

WHEREAS, The presentation of written discussion of formal papers without giving opportunity for adequate rebuttal has developed at our Conventions;

Resolved, That it is the sense of this Association that such written discussions shall hereafter be excluded from the floor and the Annual Proceedings, unless previously presented to and passed upon by the Executive Committee.

No. 5.

WHEREAS, The Forest Products Laboratory of the Forest Service of the United States Department of Agriculture has continued its painstaking and valuable investigations into subjects of importance to this Association;

Resolved, That the American Wood Preservers' Association conveys to the Director and the Staff of that institution its appreciation of their work.

Resolved Further, That a copy of this resolution be sent to the Forester of the United States Department of Agriculture.

No. 6.

WHEREAS, The Eleventh Annual Convention of the American Wood Preservers' Association has been addressed by nonmembers on subjects of importance to the industries which it represents;

Resolved, That the thanks of this Association be extended to Dr. L. F. Shackell and Messrs. Harrington Emerson, T. T. Bower and F. J. Hoxie for their courtesy in preparing and presenting the enlightening results of their investigations in problems of interest to its members; and,

Resolved Further, That a copy of this resolution be sent to these gentlemen.

No. 7.

WHEREAS, The business of the American Wood Preservers' Association has been ably handled during the past year and during the Eleventh Annual Convention:

Resolved, That the members of the Association extend to the officers and committees for 1914 their appreciation.

No. 8.

WHEREAS, The usefulness of the Wood-Preservers' Bulletin has been demonstrated during the past year;

Resolved, That its publication be continued.

No. 9.

WHEREAS, Death has taken from our midst, during the past year, our worthy member, Mr. W. H. Wales, Jr.;

Resolved; That the American Wood Preservers' Association tender to the relatives of the deceased their heartfelt sympathy in their bereavement; and,

Resolved Further, That the Secretary forward a copy of these condolences to the family of W. H. Wales, Jr.

No. 10.

WHEREAS, Death has taken from our midst, during the past year, our worthy member, Edmond R. Gabbett;

Resolved, That the American Wood Preservers' Association tender to the relatives of the deceased their heartfelt sympathy in their bereavement; and,

Resolved Further, That the Secretary forward a copy of these condolences to the family of Edmond R. Gabbett.

No. 11.

WHEREAS, Death has taken from our midst, during the past year, our worthy member, Harry J. Whitmore;

Resolved, That the American Wood Preservers' Association tender to the relatives of the deceased their heartfelt sympathy in their bereavement; and,

Resolved Further, That the Secretary forward a copy of these condolences to the family of Harry J. Whitmore.

The following acknowledgment of Resolution No. 10 has been received by the Secretary-Treasurer:

Dear Mr. Angier:

I am in receipt of yours of the 26th ultimo, and I am pleased to hear of the passing of the vote of sympathy with the relatives of my old colleague, Mr. Gabbett.

His widow lives at 33 Mount Ararat Road, Richmond, Surrey, England.

It may be of melancholy interest for you to know that, since Mr. Gabbett's death, both his sons have passed away, The elder was a Lieutenant-Commander on H. M. S. "Cressy," which was torpedoed early in the war.

Yours faithfully,

PRO BURT, BOULTON & HAYWARD, *limited,*
HUBERT FERGUSSON,
General Manager of Works.

London, February 6, 1915.

THE PRESIDENT: Is there any new business? Mr. Secretary, have you any?

SECRETARY ANGIER: Nothing.

THE PRESIDENT: If not, we will pass to the election of officers. I will appoint for tellers of this election Mr. Steinmayer, assisted by Mr. Schnatterbeck and Mr. Cooper. The first in order will be

the report of the Nominating Committee. Our Nominating Committee will please come forward and make their report.

MR. HOWARD F. WEISS: Mr. President, I would like to ask you a question. Has an Honorary member, in view of the changes that have taken place, the right of suffrage?

THE PRESIDENT: He has. We will now hear from the Chairman of the Nominating Committee.

The report of the Nominating Committee was then read by Mr. Lowry Smith, the Chairman, as follows:

MR. LOWRY SMITH: In previous years nominating committees have usually presented a slate showing only one candidate for each position. The interest of the Association, standing as it does on the threshold of broader fields, requires that this Association should be led by a man of breadth of opinion and of intense interest in all phases of this great business, and it is the duty not of this Committee but of the whole Association to choose its leaders.

Your Committee recommends that nominations from the floor be invited that the fullest expression of opinion may be had. The Committee desires to express the opinion that the President should be a railroad man. The nominating committee consisted of Lowry Smith. chairman, L. B. Shipley, H. M. Rollins, C. M. Taylor, and A. E. Larkin.

THE PRESIDENT: Gentlemen, you have heard the report of the Nominating Committee. What is the pleasure of the Association on this report? Shall we accept it or reject it?

DR. H. VON SCHRENK: I move the acceptance of the report.

MR. J. B. CARD: I second the motion.

THE PRESIDENT: All those in favor of accepting the report of the Nominating Committee will please signify it by saying Aye, contrary No. The motion is carried.

Now, gentlemen, before we go to the election, I want to urge you to give this matter due deliberation. This is a very important thing that we have before us. We must have good officers of this Association. We are now ready to hear nominations for President.

MR. L. B. MOSES: It is very late, and I am not going to take up any of your time making a nomination speech. There is no one here who is not acquainted with the gentleman whom I am about to nominate. I nominate Mr. J. H. Waterman for President.

MR. F. D. FENN: I wish to second the nomination.

MR. E. A. STERLING: If it is in order to make further nominations at the present time I would like to name a man who is well known in railroad circles, a man who has taken a great interest in matters of wood-preservation, a man who has done very efficient work, the results of which are followed by practically all of us in the industry, Mr. Stimson, of the Baltimore & Ohio Railroad.

MR. T. G. TOWNSEND: I second the nomination.

THE PRESIDENT: Do we have any further nominations for the office of President?

MR. W. W. LAWSON: I move that the nominations be closed.

MR. F. D. FENN: I second the motion.

Upon the motion being put by the President it was declared carried.

MR. J. B. CARD: May I ask a question? Can the President of this Association and the Secretary-Treasurer be with one railroad?

MR. H. J. VON LEER: I believe Article V, Section 2, says: "No two or more officers of this Association in any one year shall be either officers or employees of the same company or corporation."

MR. E. A. STERLING: What has that to do with the present status of nominations?

MR. H. J. VON LEER: I was merely answering the question of the gentleman on the other side of the house.

THE PRESIDENT: The result of the election for President of your Association for the coming year is as follows: Mr. Waterman, 64 votes; Mr. Stimson, 24 votes. (Applause.)

MR. E. A. STERLING: Mr. President——

THE PRESIDENT: We will ask Mr. Waterman to come forward and preside.

MR. E. A. STERLING: Mr. President, I move that the election be made unanimous.

MR. L. B. MOSES: I second the motion.

THE PRESIDENT: You have heard the motion. Are there any remarks? All in favor of the motion will say Aye, contrary No. The motion is carried. (Applause.)

MR. J. H. WATERMAN, President-Elect, then took the chair.

PRESIDENT-ELECT WATERMAN: Gentlemen, I am not going to take your time to make a speech. I will tell you one thing. I will try to deal justly, love mercifully and walk humbly before you all. (Applause.)

The next officer is First Vice-President.

MR. S. R. CHURCH: I nominate Mr. H. S. Loud First Vice-President.

MR. W. J. SMITH: I second the nomination.

THE PRESIDENT: Are there any other nominations? We will declare the nominations closed. (Applause.) I do not think we will have to have a ballot. Will some one make a motion?

MR. F. D. FENN: I make a motion, Mr. President, that the election of the First Vice-President be made by acclamation.

MR. E. A. STERLING: I second the motion.

THE PRESIDENT: Those in favor of Mr. Loud as First Vice-President will say Aye, opposed No. Mr. Loud is elected First Vice-President. Will he come forward to the stand so that everybody can see him. (Applause.)

We will now vote for Second Vice-President.

MR. E. A. STERLING: I will nominate Mr. Lowry Smith for the position of Second Vice-President.

MR. AUGUST MEYER: I second the nomination.

MR. L. B. MOSES: I nominate Mr. F. S. Pooler for Second Vice-President.

MR. J. B. CARD: I second the nomination.

THE PRESIDENT: Are there any other nominations? The nominations are closed. Pass your ticket. Gentlemen, Mr. Lowry Smith for Second Vice-President has received 55 votes and Mr. Pooler 29. (Applause.)

MR. L. B. MOSES: I move that it be made unanimous.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: It has been moved that the vote be made unanimous for Lowry Smith. Are you ready for the question? Those in favor will say Aye, opposed No. Mr. Lowry Smith is made Second Vice-President, and we would like to have the pleasure of his company here. Gentlemen, we will now vote for Third Vice-President.

MR. A. C. HAGEBOECK: I would like to nominate Mr. Moses.

MR. W. L. BACON: I second the nomination.

MR. GEO. E. REX: I would like to nominate one of our oldest members, twenty-third on the list, who has come to us from the coast, Mr. F. D. Beal, as Third Vice-President.

THE PRESIDENT: Mr. F. D. Beal has been nominated for Third Vice-President.

MR. C. M. TAYLOR: I move the nominations be closed.

THE PRESIDENT: The nominations are closed. It has been suggested that we have nominations for Secretary while the tellers are counting the votes.

MR. C. M. TAYLOR: Mr. Chairman, I rise to present the name of Mr. F. J. Angier for Secretary-Treasurer and move that the vote be made unanimous.

MR. GEO. E. REX: I second the motion. (Applause.)

THE PRESIDENT: The nominations are closed. You have heard the motion. All those in favor of that motion will stand on their feet. Opposed stand. Sit down. Mr. Angier is your Secretary-Treasurer, and it is a very high compliment you have paid him, and it is due him. (Applause.)

MR. F. J. ANGIER: Gentlemen, I wish to thank you most sincerely. (Applause.)

THE PRESIDENT: Nominations are now in order for the Executive Committee.

MR. W. W. LAWSON: Mr. Chairman, I would like to nominate Mr. Foley.

MR. WM. A. FISHER: In line with the suggestions made by Mr. Sterling this morning that the retiring President should automatically or by unwritten law be one of the six men, I nominate Mr. Rex.

MR. GEO. E. REX: In order to expedite this matter it seems to me that it would be a good idea to have the nominations for the six members of this Committee and select the six highest.

THE PRESIDENT: There are two who have been nominated.

MR. S. R. CHURCH: I nominate Mr. Sterling.

MR. WM. J. TOWNSLEY: I should like to place in nomination the name of L. B. Moses.

THE PRESIDENT: Wait a minute. Third Vice-President, let me announce the results. It is a little irregular. For Third Vice-President Mr. L. B. Moses received 20 votes and Mr. F. D. Beal 62 votes. (Applause.)

MR. E. T. DAVIES: I move that it be made unanimous.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: It is moved and seconded that Mr. Beal be the unanimous choice of this Convention for Third Vice-President. Are you ready for the question?

THE DELEGATES: Question, question.

THE PRESIDENT: All those in favor say Aye, opposed No. The motion is carried. Shall we proceed with the nominations for the Executive Committee?

MR. GEO. E. REX: I would like to nominate Mr. E. A. Sterling.

THE PRESIDENT: Mr. Sterling has been nominated. What is your further pleasure?

MR. GEO. M. DAVIDSON: I nominate Mr. Taylor.

MR. F. D. FENN: I second the nomination.

MR. W. F. GOLTRA: I nominate Mr. Card.

THE PRESIDENT: Now you have nominated six. Do you want to nominate others?

MR. C. M. TAYLOR: I would like to nominate Mr. Trumbull.

MR. JOHN FOLEY: I would like to nominate Mr. Fisher.

MR. A. C. HAGEBOECK: I would like to nominate Mr. Joyce.

MR. E. A. STERLING: I would like to nominate Mr. Grant B. Shipley.

MR. C. M. TAYLOR: I would move the nominations be closed.

MR. F. D. FENN: I second the motion.

Upon the motion being put by the President it was declared carried.

MR. GEO. E. REX: I would suggest that we vote on six members, each man putting six names on his ballot.

THE PRESIDENT: You have to make that in the form of a motion.

MR. GEO. E. REX: I move that each member vote on six candidates.

THE PRESIDENT: And the six receiving the highest number of votes will be declared elected.

MR. GEO. E. REX: Yes.

MR. GEO. M. DAVIDSON: I second the motion.

THE PRESIDENT: Gentlemen, are you ready for the question? Those in favor will say Aye, opposed No. The ayes have it.

MR. GEO. M. DAVIDSON: Cannot the tellers count the votes and have the results announced later on? Is it necessary to wait here for them to count these six votes? It will take a lot of time, and we have got to catch the 2 o'clock train.

THE PRESIDENT: What is your pleasure, gentlemen?

MR. GEO. M. DAVIDSON: I move, Mr. President, that the tellers count the votes and announce the votes at a later time. In other words, not take the time of the Convention necessary to count all these ballots.

MR. F. D. FENN: I second the motion.

MR. S. R. CHURCH: Would not that necessitate an adjourned meeting?

THE PRESIDENT: I think it would.

MR. GEO. E. REX: Allow me to suggest that we still have the location of the next convention to settle. Why not proceed with that while we are counting these votes? We still have 20 or 25 minutes.

THE PRESIDENT: The selection of the next meeting place will now be in order. We have got a bushel of invitations. Do you want them read?

MR. GEO. M. DAVIDSON: Mr. President, I move that the next meeting place be Chicago.

MR. AUGUST MEYER: I second the motion.

THE PRESIDENT: It is moved and seconded that the next meeting place be Chicago.

MR. F. D. FENN: I move the nominations be closed.

MR. C. P. WINSLOW: I second the motion.

THE PRESIDENT: Are you ready for the question?

THE DELEGATES: Question, question.

THE PRESIDENT: All those in favor will say Aye——

MR. GEO. E. REX: Mr. President, I was on my feet.

THE PRESIDENT: I beg your pardon, Mr. Rex.

MR. GEO. E. REX: I think we owe it to ourselves at least to read these communications from other cities. I would like for one to hear them read.

THE PRESIDENT: Well, they moved that they were not to be read.

MR. GEO. E. REX: I tried to get the floor.

THE PRESIDENT: Gentlemen, what is your pleasure?

THE DELEGATES: Question, question.

THE PRESIDENT: All those in favor of the motion say Aye, opposed No. The Nos have it. Now, Mr. Rex.

MR. GEO. E. REX: I have nothing, only I would like to have the communications read.

THE PRESIDENT: Read the names of the cities.

MR. F. J. ANGIER: We have an invitation from the Cincinnati Chamber of Commerce, together with a letter from the Mayor of Cincinnati. In addition, we have a telegram from Cincinnati which I would like to read.

St. Louis have invited us to hold our next convention in their city. They have sent a letter signed by the Mayor of St. Louis; one by the Associated Retailers; one by the Merchants' Exchange of St. Louis, and one by the Missouri Botanical Garden. Columbus, Ohio, extends a very cordial invitation; also the Merchants' Association of New York. The Charleston (S. C.) Chamber of Commerce is anxious for us to come there.

THE PRESIDENT: Gentlemen, Chicago has been nominated. Are there any other cities?

MR. E. A. STERLING: Mr. President, I nominate the city of New York.

MR. F. D. MATTOS: I second the nomination.

MR. E. A. STERLING: The crowd has never been East. There are many of our members down there, and the Merchants' Association is always ready to extend a hearty welcome and has excellent meeting rooms and excellent facilities. I think it would do the whole crowd good to come East once.

THE PRESIDENT: Are there any other nominations?

MR. H. H. GERHARD: I nominate St. Louis.

THE PRESIDENT: Is there a second to St. Louis?

MR. P. R. WALSH: I second St. Louis.

THE PRESIDENT: Are there any other nominations? The nominations are closed. Prepare your ballots for the next meeting place. Are you willing to take a rising vote on the location?

THE DELEGATES: Yes, yes.

THE PRESIDENT: Those in favor of Chicago will stand on their feet, and the Secretary will count them.

SECRETARY ANGIER: 42 for Chicago.

THE PRESIDENT: Those in favor of St. Louis will stand up.

SECRETARY ANGIER: 2 for St. Louis.

THE PRESIDENT: Those in favor of New York will stand on their feet.

SECRETARY ANGIER: 20 for New York.

THE PRESIDENT: Chicago has it.

MR. M. K. TRUMBULL: Mr. President, while we are waiting I would like to ask a question, if I may.

THE PRESIDENT: Sure.

MR. M. K. TRUMBULL: Inasmuch as our newly elected President declares that he is going to be humble, I would like to ask the question, did you consult the Proceedings as to whether he is going to be given the title of ex-Speaker Reed or ex-Speaker Cannon?

THE PRESIDENT: I will appoint a committee to answer you.

MR. F. D. MATTOS: Before leaving San Francisco I was asked by the representatives of the Panama Pacific Exposition to present to this Association an invitation to attend the Panama Pacific Exposition, to be held this year in San Francisco, and what they wondered is if we could get together in some way and hold a sort of informal meeting some time while the Fair was in session.

THE PRESIDENT: We will refer that to the Executive Committee.

MR. E. A. STERLING: Apropos of that remark I might explain that arrangements have already been made by the Western Conservation Association and the Western Logging Congress and by the Ameri-

can Forestry Association to hold a joint meeting in San Francisco, according to present plans, about the 19th of October. It is just a fair time of the year, but they have to hold their meetings toward the fall. Those are three strong organizations, and they are going to bring a lot of people, and since their interests are somewhat in common with ours, it would be a good time, if the Committee considers it at all, to hold the meetings in San Francisco. A trip has been planned up into the redwood country, and special trains have been arranged to see these sights, and we will have the Convention at our disposal.

THE PRESIDENT: Do you see any objection to leaving that with the Executive Committee?

MR. E. A. STERLING: No. I have just given this as information.

THE PRESIDENT: Has anyone any announcements? The San Francisco people had some representatives here and they wanted to see me today when I had a paper to read. I have not seen them since.

The Secretary will read the results of the ballot on the Executive Committee.

SECRETARY ANGIER: Rex, 77; Davidson, 58; Card, 54; Foley, 42; Sterling, 41; Taylor, 39. These are the six highest. (Applause.)

THE PRESIDENT: Will some one make a motion that the election be made unanimous for the six highest?

MR. GRANT B. SHIPLEY: I will make that motion.

MR. F. D. MATTOS: I second the motion.

THE PRESIDENT: Those in favor of the motion will say Aye, opposed No. The motion is carried. Adjournment is the next in order.

MR. M. K. TRUMBULL: I move that we adjourn.

MR. G. A. LEMBCKE: I second the motion.

Upon the motion being put by the President, it prevailed, and the Eleventh Annual Convention of the American Wood Preservers' Association then adjourned.

STATISTICAL DATA

QUANTITY OF WOOD PRESERVATIVES CONSUMED AND AMOUNT OF WOOD TREATED BY WOOD-PRESERVING PLANTS IN THE UNITED STATES IN 1914.

By Clark W. Gould, U. S. Forest Service.

The American Wood Preservers' Association.
In Co-operation with the Forest Service, United States Department of Agriculture, Henry S. Graves, Forester; Office of Industrial Investigations, O. T. Swan in Charge.

Summary.

In 1913 statistics based upon reports from 93 wood-preserving plants showed the most notable progress ever recorded for the industry.

Similar figures for 1914, based upon reports from 94 plants, show that the total number of cubic feet of material treated exceeded the 1913 total by 5,968,751 cubic feet, while 3,577,571 more cross ties were handled than in the previous year. The amount of piling treated was increased by 103,980 cubic feet, wood block by an amount equivalent to nearly a quarter of a mile of pavement.

These plants consumed 745,456 more pounds of dry zinc chloride in 1914 than during the preceding year. In the past year 79,334,606 gallons of creosote oil, 27,212,259 pounds of dry zinc chloride and 2,486,-637 gallons of miscellaneous liquid preservatives including coke oven-tar, refined coal-tar, crude oil and carbolineum oils were consumed. With these preservatives the plants treated a total of 159,857,057 cubic feet of materials.

In the total of 108,337,359 gallons of creosote oil consumed by the plants in 1913 paving oil was included. This commodity is considered separately in this report, the plants reporting the use of 9,429,444 gallons in 1914, which, in part, accounts for the 28 per cent. decrease in consumption of the creosote. Each year a few plants fail to respond to the request for statistics of preservative consumption and classes of materials treated. By including estimates for these plants, it is probable that the total consumption of preservatives would be increased by approximately 10,000,000 gallons of creosote and 300,000 pounds of zinc chloride.

Status and Growth of the Wood-Preserving Industry.

Wood-preservation began in the United States in 1832 when the Kyanizing process, which employs bichloride of mercury, was inaugurated. Five years later zinc chloride was employed in the Burnett process, and at the same time the use of coal-tar creosote was introduced by Bethel. At first the demand for treated wood was confined to

comparatively few forms and kinds of material, owing to the large supply of cheap and durable timbers, and as the equipment was expensive and the success of the processes considered uncertain, the growth of the practice of wood-preservation was comparatively slow.

In 1895 there were 15 plants operating, but since that time many new and larger equipments have been installed.

In 1914 the Forest Service records showed 122 plants of all types, 100 of which were of the pressure-cylinder type.

The value of treated wood is more widely recognized by the consumers now than ever before, and statistics portraying the industry in all its phases are of great interest to those concerned in wood-preservation. With the rapid advance of this industry as a whole, the choice of the kinds of preservatives has been fairly well established, but the kinds and classes of materials to be treated need development along certain lines. In Germany and other European countries practically all cross ties laid by the railroads are treated with chemicals or preserving oils. In this country but 30 per cent. of the ties purchased by the railroads are subjected to such treatment. The number of poles treated in this country is a very small per cent. of the total in use, and less than one-sixteenth of all pavements laid in 1913 was of treated wood.

Source of Statistics.

The figures presented in this report are based upon the schedules returned by the managers or superintendents of 94 wood-preserving plants in this country. This report does not include figures upon the consumption of preservatives under methods which do not require the use of treating-plant equipment, since such consumers are so numerous that it is very difficult to secure such statistics. The majority of the plants reporting are so-called commercial plants which treat material for other firms. Thirty-eight are private plants, including 27 operated by railroad companies. Of the 122 plants on the list 11 did not operate during 1914 and 17 failed to return the schedules. However, the totals were based on a greater number of reports than those of any preceding year, and but few of the plants which failed to report are of large capacity.

In 1914, as in previous years, the statistics were collected entirely by correspondence, and as tabulated are directly comparable. All individual reports are considered as confidential and totals are only published in such manner that the identity of the firms is secure. The reports furnished by the managers or superintendents of the treating plants are of such character that the report compiled from these data is the most complete and accurate resume of the industry published.

Value of Statistics.

Complete and frequent statistics upon an industry which cover a number of years are of value in several ways to all interested in wood-preservation. The current demand upon the several preservatives is clearly shown and the bearing on the future supply indicated. The trade is enabled to direct its energies toward the weaker fields and also measure the progress of such efforts in those directions. Statistics are also of value to the Forest Service and other investigative institutions in directing the experimental work on problems of the industry. By placing the printed report in the hands of the public confidence in treated wood and demand for such material is stimulated. Statistics are especially valuable to an association, since the opinions of its members can be obtained on situations of importance to the whole industry, and where voiced as a unit, carry more weight toward solving problems arising during critical periods.

The Consumption of Preservatives.

In Table I the consumption of wood preservatives used by the treating plants is shown by years, kinds of preservatives and quantities. For 1910, 1911 and 1912 the increase in the use of creosote oil was approximately 10,000,000 gallons annually. The greatest consumption of preservatives was recorded in 1913. In 1914 the total quantity of

TABLE I.

CONSUMPTION OF WOOD-PRESERVATIVES BY THE TREATING PLANTS IN THE UNITED STATES, 1909-1914.

Year.	Number of Plants.	Creosote, Gallons.	Zinc Chloride, Pounds.	Other Preservatives, Gallons.*
1909	64	51,431,212	16,215,107	**
1910	71	63,266,271	16,802,532	2,333,707
1911	80	73,027,335	16,359,797	1,000,000
1912	84	83,666,490	20,751,711	3,072,462
1913	93	108,373,359	26,466,803	3,885,738
1914	94	79,334,606	27,212,259	9,429,444*** 2,486,637

* Includes crude oil, coke oven-tar, refined coal-tar, and carbolineum oils.
** Statistics not available.
*** "Paving oil."

creosote oil reported dropped approximately 29,000,000 gallons. This was due to two facts, namely, that the supply of creosote from England

and Germany during 1914 decreased, and also that for years prior to 1914 paving oil was included in the creosote statistics. In this report paving oil, reported as 9,429,444 gallons, is listed separately.

The total consumption of zinc chloride in 1914 exceeded the 1913 figures by approximately 750,000 pounds.

The employment of miscellaneous oils for the treatment of wood was confined very largely to those plants situated in the Interior Eastern Region, because these oils are produced by local gas plants and at coke ovens and are cheaper than creosote oil or zinc, which must be transferred from the distant producing points in the east and west. Crude petroleum is considered by some consumers to best meet the requirements of their specific conditions.

Table II* shows the importation of creosote from the British Isles and Germany for a period for six months, including August, 1914, to January, 1915. The grand totals for 1914 show that the treating plants consumed more creosote oil than recorded as imported into the United States. This may be accounted for by the reason that the plants did not consume all the oil purchased from foreign countries in 1913, and the excess was consumed in 1914. The present situation seems to warrant consideration as to the availability and supply of other preservatives to fill the needs of the treating plants.

TABLE II.

IMPORTS OF GERMAN AND ENGLISH CREOSOTE FROM AUGUST 1, 1913, TO JANUARY 1, 1915.*

1913		1914	
Month.	Gallons.	Month.	Gallons.
August, 1913	4,540,073	August, 1914	5,022,019
September	4,351,654	September	4,320,633
October	3,432,955	October	845,694
November	5,546,863	November	5,107,508
December	6,092,175	December	1,598,139
January, 1914	3,106,189	January, 1915	200,841
Total	27,069,909	Total	17,094,834
Grand totals of creosote from all foreign countries for 12 months	69,021,942		48,839,020

*Bureau of Foreign and Domestic Commerce.

In Table II total imports from Germany and England are listed by months from August through January for 1913 and 1914. Some firms have experienced considerable difficulty in obtaining their supply of foreign oil and this has been very largely due to the lack of obtaining tank steamers for its transportation. Some of the larger manufacturers of creosote oil in the United States estimate that the production of the American article has been increased by 25 per cent., owing to the installation of new coke ovens. However, many of the coke ovens which manufacture the crude coal-tar have not been operating; consequently this increased production has not been felt materially to date.

The relative quantities of domestic and foreign creosote oil are shown in Table III. England and Germany were the source of all foreign oil obtained by the plants in 1914. In these countries the development of large chemical plants for refining coal-tars have been most extensive. The difference in the totals of creosote oil consumed for 1913 and 1914 was nearly equally distributed between the foreign manufacturers and the American producers of this commodity.

As stated above 9,429,444 gallons of paving oil was reported separately in 1914, and doubtless the total for creosote in 1913 and for preceding years contained considerable quantities of this heavier oil. If paving oil is considered in the total of creosote for 1914 it shows clearly that the American manufacturers made considerable progress in supplying the demand for this preservative to the treating plants.

TABLE III.

RELATIVE QUANTITIES OF DOMESTIC AND IMPORTED CREOSOTE USED IN THE UNITED STATES, 1909-1914.

Year.	Total Creosote Used, Gallons.	Domestic Creosote, Gallons.	Per cent. of Total.	Imported Creosote, Gallons.	Per cent. of Total.
1909	51,426,212	13,862,171	27	37,569,041	73
1910	63,266,271	18,184,355	29	45,081.916	71
1911	73,027,335	21,510,629	29	51,516,706	71
1912	83,666,490	31,135,195	37	52,531,295	63
1913	108,373,359	41,700,167	38	66,673,192	62
1914	79,334,606	28,026,870	35	51,307,736	65

The shipments of European creosote since August, 1914, have been unsteady.

The price of domestic creosote averaged in 1914 in the neighborhood of 8 cents to 8½ cents per gallon, f. o. b. plant. Very few quotations for creosote are being given for 1915 delivery, but, owing to the scarcity of oil, prices for 1915 probably will be somewhat higher. Much the same condition exists in the production of zinc chloride owing to the inability to obtain spelter. However, some firms are buying their supplies of this preservative at very slight increase over the figures current in 1914.

Increased amounts of creosote oil may have to be produced in the United States in the future owing to the perfection in Europe of engines using such oil as a fuel. Also in European countries increasing amounts of tar are being used for road making, and as tar is distilled for commercial creosote the tendency is to reduce the quantity of creosote oil manufactured in Europe for preservation purposes. Considerable progress has been made in this country on some plants located in the middle west, which when completed, will add 10,000,000 or more gallons annually to the supply of domestic creosote. These relative quantities of domestic and foreign creosote consumed during recent years are shown in Diagram 1.

The Regional Division of the Wood-Preserving Industry.

In Table IV the statistics have been tabulated to show the division of the United States into five districts. These districts are indicated on the accompanying map. The consumption of wood-preservatives and the kinds of material treated by the plants in these several regions is shown. The material is here shown in the form and quantities as reported by the plants instead of in cubic feet as in Table VI.

The divisions are made arbitrarily, consisting of the Pacific Coast Region, including Oregon, Washington and California. The Southern Coast Region includes the South Atlantic and Gulf States south of Virginia, together with Arkansas.

The Northern Coast Region includes the Coast States north of North Carolina, while the remainder of the country is divided into the Interior Eastern and Interior Western Regions, which are separated by the north and south line running through the center of Nebraska.

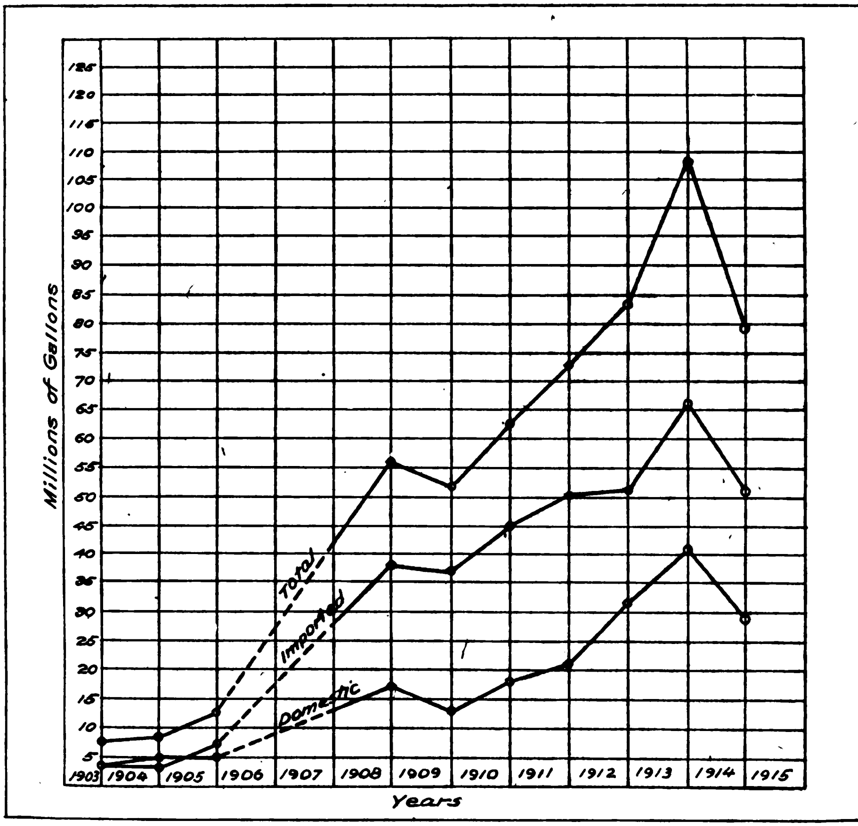
The demand for creosote oil was largest in the Southern Coast Region in 1914, and this area depends largely upon imported oil for treatment.

The eighteen plants in the Northern Coast Region, which together consume approximately 23,000,000 gallons of oil annually, used a large per cent, of imported oil also.

In the Interior Eastern Region more domestic creosote was consumed than in any other area, which made up two-thirds of their

DIAGRAM I.

PROGRESS OF WOOD PRESERVATION IN THE UNITED STATES
CONSUMPTION OF CREOSOTES FROM 1903—1914.



Note: Figures not available for years 1906-1907

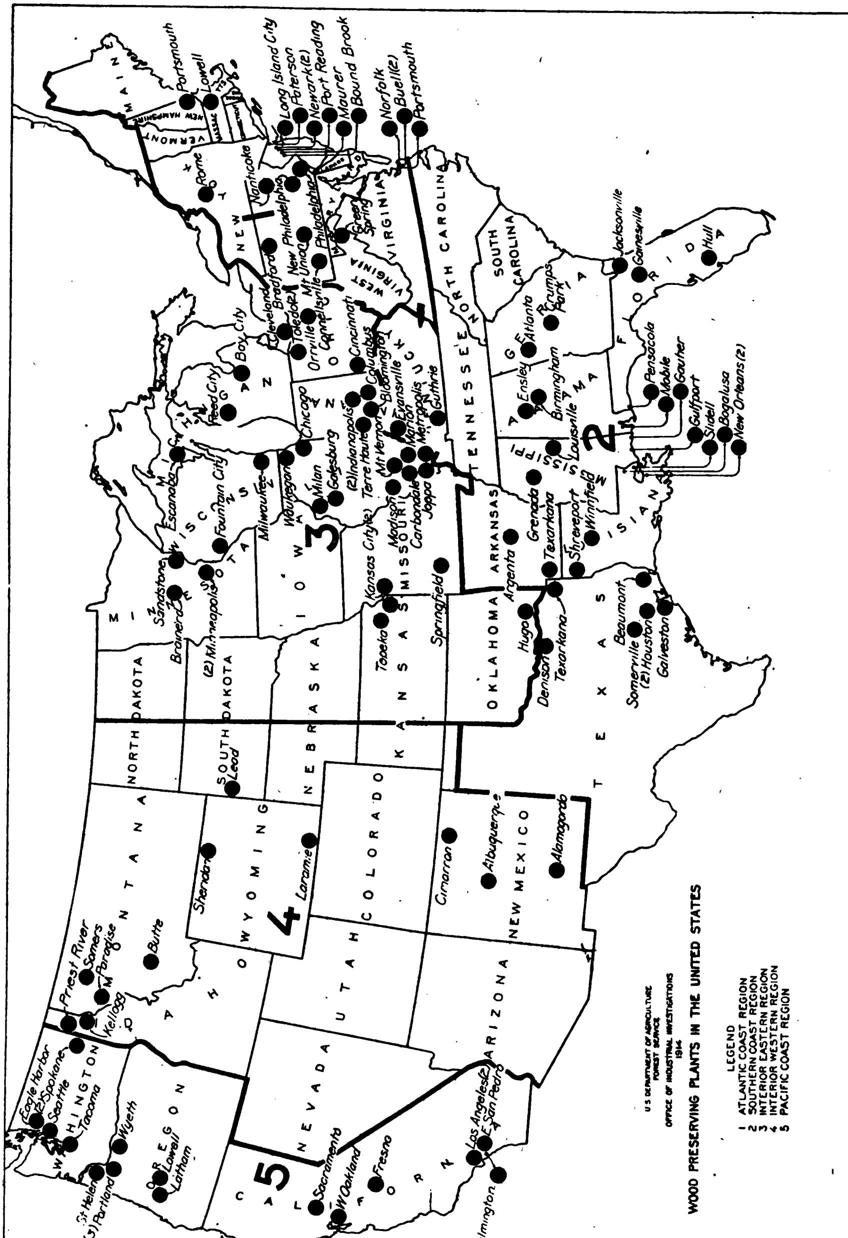
OFFICE OF INDUSTRIAL INVESTIGATIONS
U.S. FOREST SERVICE

TABLE IV.

CONSUMPTION OF MATERIAL BY REGIONS FOR 1913 AND 1914.

Region.	Year.	Number of Plants.	Domestic Creosote.	Foreign Creosote.	Zinc Chloride, Pounds.	Other Preservatives, Gallons.	Number Hewed Ties.	Number Sawed Ties.	Piling, Lineal Feet.	Number Poles.	Paving Blocks, Sq. Yds.	Timbers, Bd. Ft.	Number Cross-arms.	Miscellaneous, Bd. Ft.
Pacific Coast Region	1913	13	152,000	4,844,053	2,288,040	47,425	13,080	2,611,878	2,286,856	19,536	171,495	8,171,589	20,468	539,221
	1914	14	811,674	4,801,491	1,797,694	29,809	47,834	7,209,128	3,032,517	32,012	63,831	7,968,925	......	2,252,015
Southern Coast Region	1913	24	7,614,688	33,500,493	1,305,702	......	8,266,623	595,223	5,049,725	97,906	621,962	76,347,450	389,523	5,636,944
	1914	24	5,262,778	24,622,198	4,169,271	......	8,882,404	1,424,903	5,606,303	26,078	797,865	63,217,348	212,478	3,420,421
Northern Coast Region	1913	18	15,903,861	17,926,884	....	627,398	5,625,577	1,143,713	3,309,559	29,518	837,966	32,183,559	2,523,244	10,736,021
	1914	18	9,258,016	14,630,982	1,978,930	60,503	4,583,859	1,236,319	3,134,993	14,312	626,713	30,023,227	318,469	5,607,600
Interior Western Region	1913	30	16,651,230	9,031,908	20,011,419	483,202	16,402,857	1,629,218	585,568	952	980,495	14,953,511	......	811,125
	1914	30	11,176,668	5,573,999	14,987,581	1,650,201	14,972,969	3,107,631	436,194	....	1,128,494	13,009,636	......	3,127,625
Interior Eastern Region	1913	8	1,378,388	1,369,854	2,861,642	2,727,713	1,389,967	1,752,600	28,560	....	......	8,243,390	10,798	6,762,390
	1914	10	1,517,734	1,679,066	4,278,783	......	2,235,117	1,476,506	267,169	....	......	3,453,397	......	1,946,300
Grand Totals	1913	93	41,700,167	66,673,192	26,466,803	3,885,738	31,698,104	8,562,312	11,766,852	147,913	2,611,921	139,899,499	2,944,045	24,485,701
	1914	94	28,026,870	51,307,736	27,212,259	2,126,349	30,222,183	13,624,804	11,920,601	72,402	2,616,903	118,220,904	547,582	16,353,961

Note.—These totals are based on the 94 firms that reported to the Forest Service. The estimates made for delinquent firms are not included.



U S DEPARTMENT OF AGRICULTURE
FOREST SERVICE
OFFICE OF INDUSTRIAL INVESTIGATIONS
1914

WOOD PRESERVING PLANTS IN THE UNITED STATES

LEGEND
1 ATLANTIC COAST REGION
2 SOUTHERN COAST REGION
3 INTERIOR EASTERN REGION
4 INTERIOR WESTERN REGION
5 PACIFIC COAST REGION

requirements in 1914. In this district over half of the entire amount of zinc chloride reported by the five districts was consumed. Over twice as much material was treated by zinc chloride in the Interior Western Region than by creosote oil. Nearly half of the cross ties which were treated in 1914 were handled in plants in the Interior Eastern Region. Approximately 20 per cent. were treated in the Southern Coast area. Nevertheless, the treatment of cross ties was very important in the activities of all plants in the several districts.

More piling was treated in the Atlantic and Gulf Coast Regions, although considerable quantities were run through the cylinders of the Pacific Coast plants. The treatment of poles was more extensive in the Pacific Coast area than in any other region.

More paving blocks were treated in the Interior Eastern area than in any other region, followed by those plants situated in the Gulf States and in the New England States.

Over 93,000,000 board feet of construction timbers were treated by the plants in the Northern Coast and Southern Coast regions. The treatment of cross-arms was confined very largely to plants in the East and South.

Table IV shows the activities of all plants by regions for 1913 and 1914. The greatest growth in the consumption of domestic creosote was made by the Pacific Coast Region. The Interior Eastern Region recorded the only increased consumption of foreign oil and also in the use of zinc chloride. The increased number of sawed ties by the plants in the Pacific Coast and Interior Eastern Regions accounts for the greatest quantity of this class of material ever treated.

The treatment of piling advanced in the Pacific Coast, Northern Coast and Interior Western Districts. The growth in paving-block treatment was most apparent in the Southern Coast and Interior Eastern areas. The treatment of construction timbers and cross-arms fell off in every region. The treatment of miscellaneous lumber increased in the Pacific Coast and Interior Eastern Regions.

The wood-preserving plants in Canada consumed 3,503,640 gallons of creosote oil in treating 1,081,750 cross ties, 139,858 square yards of paving blocks, 300 poles, 1,940 lineal feet of piling, 704,000 board feet of construction timbers, and 56,257 board feet of miscellaneous material.

Preservation of Ties.

The number of ties treated in 1914 exceeded the total in 1913 by 3,577,571. The hewed ties treated comprised about 70 per cent. of the total or 30,222,183 ties, while 13,624,804 were sawed. A few companies treated more hewed ties in 1914 than in 1913, owing to the fact that more tie cutters were available during 1914 than in the preceding year. Nevertheless, the increase in the total number of cross ties treated is reflected chiefly in sawed ties. Oak ties lead in the number

TABLE V.

NUMBER OF CROSS TIES TREATED, BY KINDS OF WOOD AND KINDS OF PRESERVATIVES, IN 1914.

Preservative.	Oak.	Yellow Pine.	Douglas Fir.	Western Pine.	Beech.	Gum.	Tamarack.	Maple.	Birch.	Elm.	Other Species.	Total.
Creosote	6,537,857	7,102,396	5,452,516	712,631	572,828	255,672	183,044	419,535	126,735	1,972	1,226,257	22,591,443
Zinc Chloride..	8,549,073	1,866,627	2,221,163	1,656,721	352,415	536,267	340,462	132,644	......	41,358	976,855	16,673,585
Zinc Chloride and Creosote	1,159,929	111,998	......	......	114,466	32,091	......	28,728	......	......	509,066	1,956,278
Miscellaneous.	148,275	1,526,248	57,085	......	......	86,833	290,424	......	208,700	......	308,121	2,625,681
Total........	16,395,134	10,607,264	7,730,764	2,369,764	1,039,709	910,863	813,930	580,907	335,435	43,330	3,020,299	43,846,987
Per cent. of each kind of total number treated.......	37.39	24.19	17.63	5.40	2.37	2.08	1.86	1.32	.77	.10	6.89	100

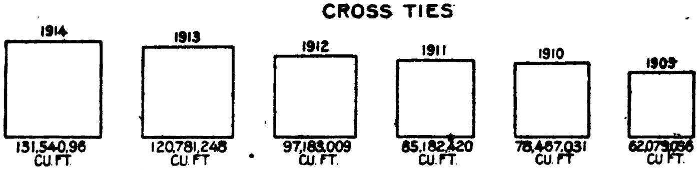
treated, followed by southern yellow pine, then in order of importance were Douglas fir, western pine, beech, gum, tamarack, maple, birch and elm. The number of miscellaneous ties was divided among cypress, ash, hickory, sycamore, poplar, cherry, etc.

Over 39,000,000 ties were treated by creosote and zinc chloride, approximately one-half of the total being reported under each class. Over 50 per cent. of the ties treated with zinc chloride were oak. The most common treatment of pine was made with creosote, and 1,159-929 ties of the total 1,956,278 treated with zinc and creosote emulsion were oak. Zinc creosote emulsion was used for treating 1,956,278 cross ties; 2,625,681 ties were impregnated with miscellaneous preservatives, including crude oil, paving oil, refined coal-tar and oils reported as carbolineum. The treatment varied from dipping in open tanks, as practiced by some traction lines, to heavy penetration of 10 to 12 pounds of oil per cubic foot by steam railroads. In the future, extension along this line is anticipated.

Approximately 135,000,000 ties are purchased annually by railroads, and although much progress has been made in tie treatment to date, but 43,846,987 ties are run through cylinders, showing clearly that many more ties can be treated to advantage.

Below is shown graphically by squares the growth registered in tie preservation.

CROSS TIES



Preservation of Poles.

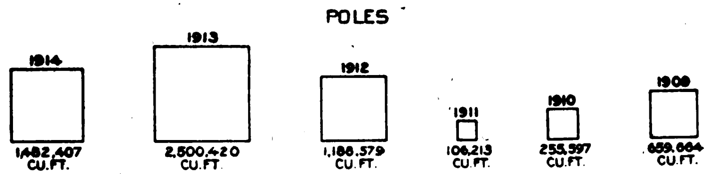
More poles are treated by brushing or dipping the butts than are reported by wood-preserving plants. This report deals only with poles treated by cylinder or open-tank plants. In 1914, 2,526,257 lineal feet of poles were treated. The lengths varied from 10 to 75 feet, the average length being about 30 feet. The most common lengths were 25, 30, 35 and 40 feet.

Sufficient detailed information as to species and treatment was not furnished by the plants to warrant a tabular presentation of pole statistics. From data published in the 1913 report, taken from a table prepared by the Forest Service and the Bureau of the Census, entitled "Poles Purchased," it is conclusively shown that the less durable woods are not being utilized to any great extent. By proper treatment less durable local woods can be made to last as long as untreated durable

species which because of the cost incurred by long hauling are more expensive.

In treating poles in 1914 the plants used in all cases one preservative, creosote oil; yellow pine comprised 90 per cent. of the total, followed by Western red cedar and Douglas fir. The absorption was about 11 pounds per cubic foot.

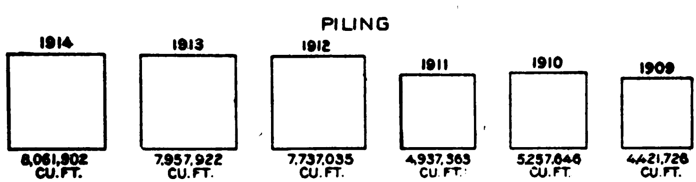
Rueping, Bethel, Full Cell and Open Tank processes were employed. Several new plants of the latter type were installed in the United States primarily for treating poles. The open-tank plant treats the butt only, and consequently a saving is made in the preservatives consumed, which permits a lower cost of the treated poles to the consumer.



Preservation of Piling.

The total quantity of piling run through the cylinders in 1914 is the greatest yet recorded by the industry. About 45 per cent. of the total amount treated was reported by plants in the Southern Coast Region. The Northern Coast and Pacific Coast plants treated 3,134,993 and 3,032,517 lineal feet respectively. The lengths of piles varied from 25 to 120 feet. Yellow pine and Douglas fir were commonly treated, although in 1914 progress has been made in the quantity of oak impregnated with oils.

Creosote was employed in 90 per cent. of the plants, and the balance were treated with zinc creosote emulsion and miscellaneous oils. Rueping and Bethel processes, using from 8 to 30 pounds of creosote per cubic foot, were the common methods employed.



Preservation of Paving Blocks.

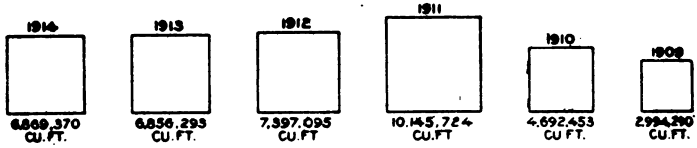
The quantity of paving blocks increased by about 5,000 square yards in 1914 over 1913 figures, and this total was exceeded only in 1911. Yellow pine comprised over 90 per cent. of the total, 2,616,903

square yards. Nearly half of the total was handled by the plants of the Interior Eastern Region. Douglas fir, tamarack, maple and gum were treated.

It is believed that this branch of timber treating can be extended, since in 1913 the principal cities in the United States laid about 33,000,000 square yards of all kinds of street paving, of which but 2,000,000 yards were wood blocks. That total, however, does not include wood blocks laid by city traction companies.

All blocks were treated with oils, and the most of the paving oil consumed by the plants in 1914 was used in this line of preservation. The growth in preservative treatment of wood blocks is shown by the diagram below.

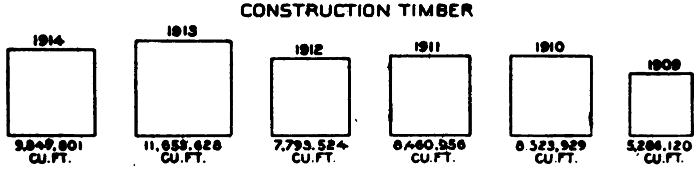
PAVING BLOCKS



Preservation of Construction Timbers.

This classification includes primarily bridge timbers, switch ties and other heavy structural material. This class is principally treated with creosote, and zinc and creosote emulsion by the plants. In other regions than the Pacific Coast, where Douglas fir is used entirely, yellow pine forms the bulk of the wood under this head; however, some hardwood, such as oak, is used. The Southern Coast Region impregnated over 50 per cent. of the total or 63,217,348 board feet. Northern Coast area was next. The average absorption varied from 4½ to 24 pounds of creosote per cubic foot.

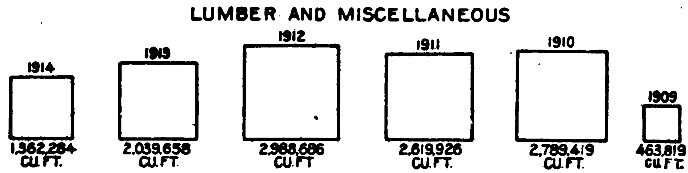
CONSTRUCTION TIMBER

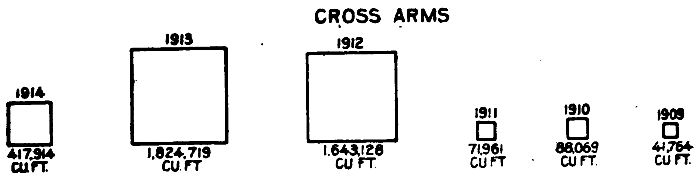


Miscellaneous Lumber.

Miscellaneous lumber includes tie plugs, stulls, shingles and lumber. The plants in the Northern Coast Region lead all other regions in the treatment of this material. The other areas contributing to the total were Southern Coast with 3,420,421 board feet, Interior Eastern region 3,127,625 board feet, Pacific Coast 2,252,015 board feet and 1,946,300 board feet in the Interior Western Region. Creosote and zinc chloride were commonly used. The treatments were not as heavy for con-

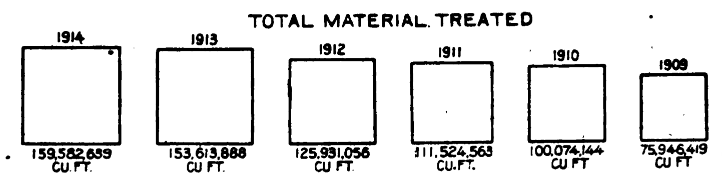
struction timbers. The treating of this class of material is gradually decreasing, owing to the better classification of material treated as reported by the managers of the plants.





Comparative Statement of Material Treated.

A comparative summary statement showing amount of material of each class treated by the principal preservatives from 1909 to 1914 inclusive is presented in Table VI. The record of the development of the wood-preserving industry in the United States is shown. The grand total of material treated exceeds the previous high mark attained in 1913 by 5,968,751 cubic feet.



Cross ties constitute the bulk of wood treated, and it is in this direction greatest gains have been recorded. Similar gains were made in piling and paving blocks. However, extension in all phases may be anticipated.

The amount of creosote oil employed per cubic foot of timber for all classes of material as reported varied from 4½ to 30 pounds of creosote per cubic foot, averaging about 8 pounds, or nearly a gallon of oil, to the foot. The treatment with zinc ranged from one-fourth to a half a pound of the dry zinc chloride per cubic foot of wood, but four-tenths of a pound was about the average.

TABLE VI.

COMPARATIVE STATEMENT OF MATERIAL TREATED IN THE UNITED STATES, 1909-1914.

Preservative.	Year.	Cross Ties, Cubic Ft.	Piling, Cubic Ft.	Poles, Cubic Ft.	Paving Blocks, Cubic Ft.	Construction Timbers, Cubic Ft.	Cross-Arms, Cubic Ft.	Lumber and Miscellaneous, Cubic Ft.	Total Material Treated Each Year, Cubic Ft.
Creosote	1909	29,830,080	4,421,726	659,664	2,994,290	4,902,311	41,764	417,787	43,267,622
	1910	44,525,229	5,219,254	255,597	4,692,453	7,801,272	88,069	2,687,713	65,269,587
	1911	49,532,163	4,937,363	106.213	10.145,724	7,417,105	71,961	2,499,995	74,710,524
	1912	57,461,515	7,624,939	1,169,981	7,091,658	6.892,493	1,643,128	2,841,195	84,724,909
	1913	75,998,307	7,630 328	2,367,769	6,810 308	10,308,883	1,813,010	1.853 993	106,782,598
	1914	67,774,329	7,804,657	1,188,511	8,127,506	8.389,158	395,403	1,348,566	90,027,630
Zinc Chloride....................	1909	24,153,162	a	a	a	320,891	a	2,333	24,476,386
	1910	27,587,583	a	a	a	541,514	a	71,060	28,200,157
	1911	28.337,883	a	a	a	1,043,851	a	119,931	29,501,665
	1912	28,532,874	a	18,246	a	259,972	a	20,092	28,831,184
	1913	36,051,816	a	47,996	a	585,756	a	7,670	36,693,238
	1914	50,020,755	a	b	a	1,317,925	a	4,355	51,343,035
Zinc Creosote....................	1909	8,095,794	a	a	a	62,918	a	43,699	8,202,411
	1910	6.354,219	38,392	a	a	181,143	a	30,646	6,604,400
	1911	7,312,374	b	a	a	b	a	b	7,312,374
	1912	8,214.303	97,874	a	a	560,613	a	99.367	8,972,157
	1913	6,938,838	327,594	a	b	758.989	a	53,628	8,079,049
	1914	5,868,834	a	a	b	140,718	a	b	6,009,552
All Preservatives................	1909	62,079.036	4,421,726	659,664	2,994,290	5.286,120	41,764	463,819	75,946,419
	1910	78,467.031	5,257,646	255,597	4,692,453	8.523 929	88,069	2,789,419	100,074,144
	1911	85.182.420	4.937,363	106,213	10,145,724	8,460,956	71.961	2.619.926	111,524,563
	1912	97.183 009	7.737,035	1,188,579	7,397,095	7.793 524	1,643.128	2.988,686	125,931,056
	1913	120,781,248	7,957,922	2,500,420	6,856,293	11,653,628	1,824.719	2,039,658	153,613,888
	1914	131,540,961	8,061,902	1,482,407	6,869 370	9,847,801	417,914	1,362,284	159,582,639

NOTE.—Figures furnished by United States Forest Service.
a.—No statistics.
b.—Figures, if used, would reveal identity of reporting firms.

CONVERTING FACTORS.

To obtain the number of cross ties, divide figures shown by 3.
To obtain the number of lineal feet of piling, divide the figures shown by .6763.
To obtain the number of lineal feet of poles, divide the figures shown by .5868.
To obtain the number of square yards of paving blocks, divide the figures shown by 2.625.
To obtain the number of board feet of construction timbers, divide the figures shown by .0833.
To obtain the number of cross-arms, divide the figures shown by .6198.
To obtain the number of board feet of lumber and miscellaneous material, divide the figures shown by .0833.

TIMBER-TREATING PLANTS IN NORTH AMERICA, DECEMBER, 1914.*

By W. F. Goltra.

The value of a complete and authentic list of wood-preserving plants in America is well recognized by everyone interested in the wood-preserving industry or as a consumer of treated material. Until a few years ago such lists as had been published possessed meager information regarding the character, capacity and equipment of plants, processes employed, kinds of wood and material treated, preservatives used and other useful information pertaining to the timber industry. A couple of years ago our Secretary, Mr. Angier, secured complete data direct from the managing companies, which enabled the author to compile the list which was published in our Proceedings in 1913 and 1914. The list has been carefully revised and corrected up to December 31, 1914.

In order to understand the letter and number prefixes given in the lists, designating the processes employed, kinds of wood and material treated and equipment of plants, capacity, etc., it will be necessary to describe these features. We will begin with a description of general methods employed for treating wood in America.

There are two general methods of impregnating wood with antiseptics, namely,

(1) Impregnating by immersion or boiling in open tanks or boilers without pressure. This is commonly known as the "Open Tank or Non-Pressure Process."

(2) Impregnating by pneumatic pressure by means of force pumps and air-tight cylinders. This process is commonly known as the "Pressure Process."

Open-Tank Process.

The first method is the simplest and oldest form for applying a preservative. As its name indicates, it consists of dipping or steeping the wood in open tanks filled with the preservative. This method is used mostly for treating the butts of telegraph poles. In some cases the wood is boiled in the preservative for several hours and then plunged into a cold preservative to obtain a more rapid and deeper penetration. Again, in some cases the wood is placed in closed cylinders and boiled, but no pressure applied. It necessarily follows that there is an absorption rather than an injection of the preservative fluid, which differentiates the "open-tank" process from the "pressure" process. It also follows that the penetration obtained is not as deep as that secured with the pressure process, when all conditions are alike. The wood must first be well "seasoned," as the absorption is much influenced thereby.

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*Compiled from reports made by various managing companies to the American Wood Preservers' Association.

Some good results are obtained by this method. "Kyanizing" is an open-tank process employing corrosive sublimate as the preservative, and that process is extensively used in European countries for impregnating telegraph poles. Of course, it is a slow process compared with that in which the wood is treated under pressure, but is suitable for treating ties and other material on a small scale, and it is considered a very practical and economical way of treating the butts of telegraph poles. Although these plants are small affairs compared with the modern pressure plants, yet the aggregate quantity of material treated by the open-tank process is very considerable. In various parts of the country we find small open tanks of various shapes and sizes, usually second-hand boilers or cylinders, with an opening cut along the upper side and a place to kindle a fire underneath. In these open tanks fence posts and timbers are boiled in the preservative, but they are not considered of sufficient importance to include in our list. Most of the plants use creosote oil, while some use proprietary preservatives.

It is difficult to give the relative capacity of these plants, as some are designed and equipped to treat butts of poles only, while others are equipped to treat mine props, timbers, etc.; consequently there is no similarity of capacity that can be compared; therefore, those data are omitted.

Pressure Process.

The second method of impregnation is the one in general use. In this method the timber is placed in cylinders with closed ends and the preservative is injected into the wood under pressure, employing force pumps or compressor pumps for the purpose. There are some variations in the operations, but the principle is the same in all of them, namely, the injection of the fluid into the wood is accomplished by the application of pressure. The various methods or processes may be classed into five groups and described as follows:

Process "A" (Bethell-Burnett-Lowry).

Ties, piling, timbers, poles, paving blocks, or whatever is to be treated, are first air-seasoned, that is, the material is piled in open air for a period of 3 to 20 months to dry out. When sufficiently seasoned it is loaded on tram cars and run into cylinders, 6 or 7 feet in diameter, 100 to 150 feet long, and doors closed. The wood is then submerged in the preserving fluid, heated to a temperature of 170° to 190° F., before admission into the cylinders. The pressure pump, or compressor, is then put into action, forcing more fluid into the cylinders.

The operation is continued and maintained until the desired absorption is obtained, or until the wood refuses to absorb any more fluid. The pressure is then released, the surplus fluid drained from the cylinder and a vacuum applied. This last operation is for the pur-

pose of hastening the drying of the material and to prevent subsequent dripping when taken out of the cylinders. The drippings are drained from the cylinder and returned to the working tank. This completes the treating operation, and the material is then withdrawn from the cylinders.

The above described method is known as Bethell process (Pat. 1838) when using creosote oil, Burnett process (Pat. 1838) when using chloride of zinc or Lowry process (Pat. 1906) when using creosote oil.

Process "B" (Preliminary Steaming-Vacuum-Pressure).

The material, when green or partially seasoned, is run into the cylinders and doors closed. Live steam is admitted at such rate as to secure twenty pounds of steam pressure within 30 minutes to 50 minutes. The pressure is maintained for periods ranging from 1 hour to 5 hours, depending upon the character of the timber and its condition. A vacuum is then applied and maintained for at least 30 minutes, at the expiration of which time the preservative fluid is admitted into the cylinder without otherwise breaking the vacuum. The wood is then submerged in a preservative fluid, heated to a temperature of 170° to 190° F., before admission into the cylinuer. The pressure pump or compressor is then put into action. The remainder of the operation is the same as Process "A," above described. This process is quite old and extensively used. It has no patent claimants.

Process "C" (Boulton-Curtis-Isaacs-Buehler).

The material, green or partially seasoned, is run into a cylinder and door closed. The wood is submerged in a preservative, usually creosote oil, the temperature of which is raised to 215° to 225° F., and the boiling maintained for periods ranging from 4 to 8 hours, depending upon the character of the timber and its condition. A vacuum is sometimes applied to assist the liberation of the saps in the wood. Pressure pump or compressor is then put into action. The remainder of the operation is substantially the same as Process "A," above described. This method is known as Boulton's process (Pat. 1879), Curtis & Isaacs' (Pat. 1895), Buehler's (Pat. 1908). This process is extensively used on the Pacific Coast for treatment of Douglas fir.

Process "D" (Rueping).

The material must first be air-seasoned, as in Process "A." It is then run into a cylinder and door closed. An initial air pressure of varying intensity is applied, and without lowering the air pressure the cylinder is filled with a preservative, usually creosote oil and having a temperature of 170° to 190° F. Pressure pump, or compression pump, is then put into action, and the pressure is raised still higher. The remainder of the operation is substantially the same as in Pro-

cess "A," above described. This process is known as the Rueping process (Pat. 1902 and reissued in 1907). The patentees call it an "empty-cell process." (See foot note.)

Process "E" (Card).

Creosote oil and zinc chloride (a water solution) have different specific gravities, and, therefore, separate from each other unless kept in agitation.. When it is desirable to use a mixture of these two preservatives for the treatment of woods it is necessary to keep the solution in agitation in the treating cylinder while it is being forced into the wood. A device for this purpose has been invented and patented by Mr. Card. The emulsion of zinc chloride and creosote oil is made and forced into the wood in one operation. This is known as the Card process (Pat. 1906).

Species of Wood Treated.

The varieties of wood treated are many and depend to a large extent upon the kind of timber available in the locality of the treating plant. In order to facilitate replies the Association's circular letter of inquiry gave a list of woods in North America, as given below, to which is prefixed an index number:

Northern Forest.

100	White Pine	105	Birches	110	Tamarack
101	Red Pine	106	Hemlocks	111	Maples
102	Jack Pine	107	Beech	112	Ashes
103	Spruces	108	Chestnut	113	Cedars
104	Balsam Fir	109	Poplars	114	Aspens

Central Forest.

115	White Oak	122	Yellow Poplar	129	Buckeyes
116	Black Oak	123	Cherry	130	Cottonwoods
117	Red Oak	124	Ashes	131	Black Gum
118	Hickories	125	Elms	132	Sycamores
119	Chestnut	126	Maples	133	Butternut
120	Walnut	127	Beech		
121	Linden	128	Locust		

Southern Forest.

134	Longleaf Yellow Pine	139	Juniper	146	Butternut
135	Shortleaf Yellow Pine	140	Ashes	147	White Cedar
136	Loblolly Pine	141	White Oak	148	Elms
137	Red Oak	142	Black Oak	149	Osage
138	Hickories	143	Cypress	150	Honey Locust
		144	Black Gum		
		145	Red Gum		

Rocky Mountain Forest.

151	Yellow Pine	154	Douglas Fir	157	Balsam Fir
152	Spruces	155	Junipers	158	Aspens
153	Cottonwoods	156	Oaks		

The reverse of this process is used at some treating plants; that is, instead of applying an initial air pressure, a preliminary vacuum is applied. The effect of this operation is to leave more of a fluid in the wood. Experiments described by Mr. Howard F. Weiss and published in the American Wood Preservers' Proceedings, 1912, page 181, clearly indicate the effect of an initial air pressure or preliminary vacuum in wood upon its treatment.

Pacific Coast Forest.

159	Douglas Fir	164	Spruces	169	Birches
160	Western Red Cedar	165	Hemlocks	170	Redwood
161	Yellow Pines	166	White Pines	171	Cedars
162	Balsam Fir	167	Junipers	172	Larches
163	Cottonwoods	168	Maples	173	Alders

Tropical Forest (Mexico).

174	Pines	177	Mesquite	181	Ash
175	Mulberry	178	Elm	182	Cottonwood
176	Linden	179	Sycamore	183	Mora
		180	Ceiba		

The accompanying map shows the Forest Regions of North America. The black dots indicate the location of the plants. It will be observed that the plants are nearly all located in the forest regions, or nearly as possible to the timber supply.

Kind of Material Treated.

The United States Forest Service, in collaboration with the American Wood Preservers' Association, collected statistics pertaining to the kind and quantity of material treated in this country during year 1913. A summary of the report follows:

Kind of Material.	Cubic Feet.	Per cent.
Cross Ties	120,781,248	78.7
Piling	7,957,922	5.2
Poles	2,500,420	1.6
Paving Blocks	6,856,293	4.5
Construction Timber	11,653,628	7.6
Cross Arms	1,824,719	1.1
Lumber and Miscellaneous	2,039,658	1.3
Total	153,613,888	100.0

The Association's circular letter of inquiry gave a list of the principal kinds of material treated, as shown below, and to which an index number has been prefixed to each item, as follows:

200 Railroad Ties	205 Cross Arms	209 Wooden Pipe
201 Piling	206 Mine Props	210 Crossing Plank
202 Telegraph Poles	207 Fence Posts	211 Signal Poles
203 Dimension Timbers	208 Paving Blocks	212 Tie Plugs
204 Switch Ties		

Capacity of Plants.

The capacity of a treating plant depends primarily upon the size and number of impregnating cylinders. There are four prime factors which affect the number of ties that can be treated with a given cylinder, namely:

(1) Length and size of ties.

(2) Whether steamed and impregnated in the same cylinder or in separate cylinders.

(3) Number of hours daily that the plant is in operation.

(4) Whether or not the plant is in continuous operation throughout all seasons of the year.

Ties vary in length, some containing as little as 2.5 cu ft., while

some contain as much as 3.75 cu ft. of timber, and it is obvious that the number of ties that can be loaded on a tram varies with their size; besides this, a given cylinder will not hold as many trams of ties 8½ feet long as it would ties 8 feet long.

If ties are steamed and impregnated in the same cylinder (Process "B") obviously a less number of ties can be treated in a given cylinder.

One million 6"x8"x8' ties would be treated annually by Process "A." As these two cylinders have a volume of 7696 cu. ft., the ratio would be 130 ties per cubic foot of cylinder volume, and this is the common factor which we have used in computing the capacity of treating plants given in the accompanying list. This factor may be increased or decreased, and the author leaves it to the reader to assume whatever figure he pleases, but in doing so, it should be made applicable to all plants in estimating their relative capacity, for, as above stated, the capacity of a treating plant depends primarily upon the size and number of cylinders.

Several plants contemplate enlarging their works by increasing the length or number of cylinders, but in the report we have given the capacity of plant is based on cylinders in actual operation.

The report distinguishes those plants that do commercial work from those which treat for certain railroads exclusively. As a rule, plants owned and operated by railroad companies treat for their lines exclusively and do not handle any commercial work of any kind for outside parties. There are 66 plants owned and operated by independent companies and 30 plants owned and operated by railroad companies.

Preservatives.

The selection of the preservative, although important, is secondary to other factors which influence the durability or life of treated material. Creosote oil is an excellent preservative, but experience has demonstrated that there are other oils or chemicals which are equally as effective as preservatives and much cheaper. Coal-tar creosote is a byproduct of a byproduct and is not manufactured expressly for preservative purposes. It varies greatly in its chemical composition—coal-tar obtained from different coal produces different kinds of creosote oil. The literature on the subject of specifications and methods of analysis of creosote oil is voluminous and bewildering, and the specifications are continually changing. The consumers have rather definite ideas as to the quality of creosote desired, but, unfortunately, it has been necessary to base the specifications on the kind of oil available, both abroad and in this country, rather than to make arbitrary standards and expect the manufacturers to meet them.

Several additional problems relating to the use of creosote oil as a preservative are pressing for solution. These include the advisability of using various mixtures of creosote oil and other products,

such as filtered tar, water-gas oil, or combining creosote of different grades; the use of petroleum or water-gas-tar, wood-tar creosote, either alone or in combination with pure coal-tar creosote, and the combined use of creosote oil and crude oil, or chloride of zinc. Creosote oil, however, is only one of the many preservatives proposed for the treatment of timber. Various preservatives have, from time to time, been tried and recommended, but the number of these which combine efficacy and cheapness is limited. The chief impregnating fluids in use in this country today are chloride of zinc, creosote oil and heavy crude oil. Many other substances have been used for preserving wood, but none of them has given as good results as any one of these three. Up to the year 1900 approximately 15,000,000 ties were treated in the United States, of which about 14,500,000 were treated with chloride of zinc and 500,000 with creosote oil.

For various reasons the consumption of creosote oil greatly increased and surpassed that of zinc chloride, to the extent that over twice as many ties were treated with creosote oil as with zinc chloride during the year 1913. The increasing use of creosote oil has produced a very severe shortage of this material, with a resulting rapid increase in price. About 62 per cent. of the creosote oil used by the treating plants in the United States is imported, chiefly from England and Germany. The European war almost completely shut off this importation, and several plants were compelled to close down on account of the scarcity of this commodity. The quantity of creosote oil consumed in the preservation of ties and timbers has increased from 7,700,000 gallons in 1903 to 108,373,000 gallons in 1913.

Chloride of zinc is an efficient and cheap preservative. It has been used longer than any other preservative and the service records, both in Europe and America, attests to its merits as an excellent wood preservative. Like creosote oil the quantity consumed in the preservation of material has increased from 10,500,000 pounds in 1903 to 26,466,000 pounds in 1913. All other preservatives, including crude oil, consumed during the year 1913, amounted to 3,885,000 gallons.

Ordinarily ties and timbers, when treated with chloride of zinc, are treated to refusal. The solution is usually made 2 per cent. to 5 per cent. strong. The average absorption is 1.5 pounds of salt per tie, which at 3½ cents per pound, amounts to between 5 and 6 cents per tie.

Creosote oil is much more expensive and the price constantly advancing. Ten years ago it was selling at 6 cents a gallon, while today the price is around 10 cents a gallon. Thoroughly seasoned ties, treated to refusal, will absorb an average of 4½ gallons of oil per tie, or 40 to 50 cents worth of oil at current prices. This makes it almost prohibitive to treat ties to refusal, so we find it is a common practice to inject only a partial or light dose of oil, say 2½ gallons of oil, or

less, per tie. Where such practice prevails it is frequently observed that the ties are only partially treated.

It is poor economy to stop the operation or injection of creosote oil before the receptivity of the timber is exhausted in order to reduce the cost of treating ties and timbers with this preservative. Far better it would be to use a combination of creosote oil and chloride of zinc and treat the material to refusal.

The combination of creosote oil and chloride of zinc meets with much favor, both in this and European countries. The mixture consists of 12½ per cent. creosote and 87½ per cent. zinc chloride solution. The cost, based on the above prices, would be about 11 cents per tie.

Growth of the Industry in America.

Timber treating on what might be considered on an extensive scale in this country was undertaken by the A., T. & S. F. R. R. at Las Vegas, N. M., in 1885. Up to that time there were only three pressure plants in existence. From that time on the number of plants constructed annually grew rapidly. At the close of the year 1890 there were 8 plants, in 1895 12 plants, in 1900 15 plants, in 1905 34 plants, 1910 74 plants, at the close of the year 1914 95 plants in operation and one under construction. Thus 81 of the 96 pressure plants in the United States have been built during the past 14 years.

Not only has the number of plants greatly increased but so has their capacity. At the close of the year 1903 there were only 27 plants in operation, with an aggregate capacity of 21,350,000 ties per annum, or its equivalent in timber and other material, while at the end of 1914 the 95 plants given in the accompanying list have an aggregate capacity of 111,019,500 ties per annum, and while the number of plants has trebled their capacity has more than quintupled during the past decade.

The total number of ties treated in the year 1885 was about 120,000, which was approximately 0.25 per cent. of the estimated number of ties used during that year by all the railroads in the United States. The number treated annually increased amazingly, so that in the year 1913 40,260,000 ties received preservative treatment, being about 28 per cent. of the entire number purchased by the steam and electric railways during that year.

During the year 1914 the purchases of treated and untreated ties fell off greatly on account of general business depression. It is estimated the purchases by steam and electric railways during that year did not exceed 100,000,000, of which about 28 per cent. or 28,000,000, were treated. But with return to prosperity we will see a continuation of the marvelous growth and expansion of the industry until the bulk of the cross ties used by American railways shall receive a preservative treatment.

TABLE SHOWING MILEAGE OF STEAM, HORSE AND ELECTRIC RAILWAYS, NUMBER OF TIES USED, NUMBER TREATED, PERCENTAGE AND NUMBER OF PLANTS IN THE UNITED STATES, FROM 1860 TO 1914, INCLUSIVE.

YEAR	Steam Railroads. Miles	Steam R. R. "Othertracks." Miles	Horse and Electric Ry's. Miles	Total Miles	Ties used Number	Ties treated Number	Percentage Treated.	Plants in operation No.
1860	30,626	3,000	200	33,826		From 1860 to		
1870	52,922	9,100	1,200	63,222		1885 exclusive		
1880	93,267	21,977	2,000	117,244		Approx. 50,000		3
1885	123,320	32,868	2,800	158,988	50,000,000	120,000	0.25	5
1886	125,185	34,441	3,120	162,746	51,000,000	510,000	1.00	5
1887	137,028	37,348	3,680	178,056	56,000,000	594,000	1.00	5
1888	145,387	38,221	4,112	187,720	60,000,000	644,000	1.00	6
1889	153,725	42,242	4,930	200,897	63,000,000	615,000	1.00	7
1890	166,703	44,882	5,241	216,826	68,000,000	650,000	1.00	8
1891	168,403	46,683	6,155	221,241	70,000,000	697,000	1.00	8
1892	174,784	49,823	7,040	231,647	72,000,000	790,000	1.10	9
1893	175,980	53,410	8,870	238,260	73,000,000	812,000	1.10	10
1894	178,412	54,701	8,949	242,062	75,000,000	920,000	1.20	11
1895	181,717	55,209	10,810	247,736	76,000,000	1,289,000	1.70	12
1896	183,111	56,933	12,133	252,177	78,000,000	1,307,000	1.70	13
1897	184,428	58,153	13,765	256,346	79,000,000	1,312,000	1.60	13
1898	186,296	60,344	15,942	262,682	80,000,000	1,826,000	2.30	13
1899	189,294	62,581	17,665	269,540	81,000,000	2,510,000	3.00	15
1900	194,262	65,691	19,314	279,267	85,000,000	2,800,000	3.30	15
1901	197,237	70,165	22,217	289,559	88,000,000	4,101,000	4.60	17
1902	202,471	75,480	25,592	303,543	90,000,000	6,180,000	6.80	22
1903	207,977	79,376	27,754	315,107	94,000,000	9,010,000	9.60	27
1904	212,394	82,863	29,548	324,805	96,000,000	12,800,000	13.30	30
1905	217,341	85,867	32,517	335,725	100,000,000	14,890,000	14.90	34
1906	222,635	94,526	36,212	353,373	102,834,000	16,880,000	16.40	39
1907	227,670	99,651	38,812	366,133	153,703,000	19,856,000	12.90	51
1908	231,333	103,691	40,247	375,271	112,466,000	23,776,000	21.10	57
1909	234,799	107,009	40,490	382,298	123,751,000	22,032,000	17.80	68
1910	238,609	109,878	40,088	388,575	148,231,000	30,544,000	20.60	75
1911	242,885	114,940	41,088	398,913	135,053,000	31,141,000	23.00	81
1912	246,600	119,520	42,110	408,230	140,000,000	32,210,000	23.00	87
1913	250,760	126,200	43,043	420,003	145,000,000	40,260,000	28.00	92
1914	252,292	127,436	43,989	423,717	100,000,000	28,000,000	28.00	95

For the convenience to the eye the accompanying table shows the mileage of steam and electric railways, number of ties used, number treated, percentage and number of plants in the United States from 1860 to 1914, inclusive:

The steam railway mileage was obtained from Poor's Manual, the electric and steam railway mileage from the "Electric Railway Journal" of New York, for years 1900 to 1913, inclusive; prior to 1900 figures estimated by the author. The number of ties used by steam and electric railways was obtained from Forest Service Reports from years 1907 to 1913, inclusive; prior to 1907 from U. S. Census reports and estimated by the author. The number of ties treated from 1907 to 1912, inclusive, from Forest Service Reports; prior to 1907 from various publications and estimated by the author. All figures for 1913 and 1914 are estimated.

It will be observed that the trackage of all kinds at the close of the year 1914 had reached the enormous total of 423,717 miles. If auxiliary and side-track mileage of electric railways and private side tracks serving the thousands of industries were added to this the grand total of trackage in the United States would be no less than 450,000 miles and requiring no less than 135,000,000 ties a year to maintain them.

Our timber is fast waning. We are consuming it at such a reckless rate that some of us may see a day of repentance. Aside from the great economy effected by the use of treated ties and timbers, there should be in all of us that spirit of patriotism which will urge us to husband the resources of our magnificent inheritance of forests.

Canada.

Many Canadian railways are now beginning to realize the value of preserving at least a part of their tie material from decay and insect injury. The practice in Canada is just beginning, but it is increasing rapidly with the increasing cost of tie material and the constantly decreasing supply. In 1910 practically no treated ties were used by the Canadian railways. In 1911 some 206,000 ties received chemical treatment before being placed in the roadbed. This number, while forming only 1.4 per cent of the total used (14,289,224), was nevertheless an indication of the increase in this particular form of conservation.

In 1912 1,818,189 cross ties were chemically treated. This number forms 8.5 per cent. of the total number (21,308,571) of ties laid during that year. It is estimated that the number of ties laid in 1913 at 24,000,000 and at least 10 per cent. of them received preservative treatment.

No official figures are available at the present writing showing the number of ties laid in Canada during the year 1914 and the percentage

treated, but on account of the general business depression it is probable that the quantities are not as large as for year 1913. At the close of year 1914 there were five treating plants in operation in Canada. There were also two other open tank process plants operated in connection with lumber yards, but they are not of sufficient importance to include them in our list.

Railway building and development in Canada is wonderful. In the thirties and forties Canada had from 16 to 66 miles of railroad in operation. Between 1851 and 1856 the mileage grew from 159 to 1,414. In the year of confederation it was 2278, and 10 years later, or in 1877, 5782. By 1884 it had reached 10,273 and by 1904 had nearly doubled again, 19,431 miles of track being in operation. At the end of the year 1913 there were 29,304 miles, and during the year 1914 2017 miles were constructed, making a grand total of 31,321 miles of railway in Canada on Dec. 31, 1914.

Canada now holds sixth place among the nations of the world in railway mileage. This tells the world what Canadians are doing to realize on their vast and valuable heritage. In particular it shows the people of our country what enterprising neighbors we have and customers too.

The following list of wood-preserving plants in the United States, Canada and Mexico has been compiled with great care and should any errors or omissions be discovered the author will appreciate the favor if his attention is called to them.

PART I.

LIST OF WOOD-PRESERVING PLANTS IN THE UNITED STATES, CANADA AND MEXICO, JANUARY 1, 1915.

PRESSURE PROCESSES.

EASTERN STATES.

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
1	C14	Long Island City, N. Y.	Eppinger & Russell Co.	New York, N. Y.	1878	4	72	100	11,312	1,470,000
2	B14	Rome, N. Y.	Federal Creosoting Co.	Louisville, Ky.	1910	2	84	150	11,550	1,495,000
3	C14	Bound Brook, N. J.	Federal Creosoting Co.	Louisville, Ky.	1909	1	84	150	5,775	750,000
4	C14	Newark, N. J.	Amer. Creosoting Co.*	New York, N. Y.	1906	2	78	105	6,972	905,000
5	C14	Paterson, N. J.	Federal Creosoting Co.	Louisville, Ky.	1909	1	84	150	5,775	750,000
6	C14	Maurer, N. J.	Barber Asphalt Pav. Co.	Maurer, N. J.	1905	4	72	115	13,008	1,690,000
7	C13	Port Reading, N. J.	P. & R. R. R., C. R. R. of N. J.	Port Reading, N. J.	1912	2	88	140	11,368	1,475,000
8	C13	Greenwich, Pa.	Penna. R. R.	Philadelphia, Pa.	1910	2	72	132	7,466	970,000
9	C13	Mt. Union, Pa.	Penna. R. R.	Philadelphia, Pa.	1909	1	72	132	3,733	485,000
10	C13	Broadford, Jc., Pa.	Pittsburgh Wd. Pres. Co.	Pittsburgh, Pa.	1911	1	84	90	3,465	450,000
11	C13	Bradford, Pa.	Buff., Roch. & Pgh. R.R.	Rochester, N. Y.	1910	1	75	95	2,914	365,000
12	E13	Buell, near Norfolk, Va.	U. S. Wood Pres. Co.	New York, N. Y.	1907	2	78	150	9,960	1,295,000
13	E13	Buell, near Norfolk, Va.	Norfolk Creosoting Co.	Norfolk, Va.	1896	4	78	100		
						1	78	105		
					1905	1	84	125	21,578	2,800,000
14	E13	Norfolk, Va.	Atlantic Creo. & Wood Preserving Works	Norfolk, Va.		1	78	62		
						1	78	82		
					1901	1	78	126	8,964	1,165,000
15	E13	Portsmouth, Va.	Wyckoff P. & Creo. Co.	50 Church St., N. Y.	1881	4	74	102	13,000	1,690,000
16	D13	Green Spring, W. Va.	Balto. & Ohio R. R.	Baltimore, Md.	1912	2	84	132	10,198	1,325,000

For additional information see Part II.

*American Creosoting Co. with address New York City is a different concern from Company bearing same name with office at Louisville, Ky.

SOUTHERN STATES.

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
17	H12	Gainesville, Fla.......	Atlantic Coast Line R.R.	Wilmington, N. C.....	1912	2	74	138	8,252	1,070,000
18	G11	Pensacola, Fla.........	Southern Pav. Con. Co.	Chattanooga, Tenn....	1912	1	72	90	2,545	330,000
19	G12	Jacksonville, Fla.......	Eppinger & Russell Co..	168 Br'dway, N. Y....	1909	3	84	130	15,015	1,950,000
20	I12	Hull, Fla..............	Charlotte Harbor and Nor. Ry. Co........	Boca Grande, Fla.....	1912	1	74	73	2,182	285,000
21	G12	Macon, Ga............	Central of Ga. R. R. Co.	Macon, Ga............	1912	2	84	116	8,932	1,160,000
22	F12	Atlanta, Ga............	Southern Wd. Pres. Co.	Atlanta, Ga...........	1908	1	72	70	1,960	255,000
23	G12	Brunswick, Ga.........	Brunswick Creo. Co....	Louisville, Ky.........	1915	2	84	121	9,317	1,211,000
24	F12	Ensley, Ala............	Pioneer Lum.&Creo. Co.	Ensley, Ala...........	1911	1	74	76	2,272	295,000
25	G11	Mobile, Ala............	Republic Creosoting Co.	Indianapolis, Ind.......	1906	2	74	130	7,774	1,010,000
26	F11	McAdory, Ala..........	Tennessee Coal, Iron and Railroad Co....	Birmingham, Ala......	1909	1	72	65	1,838	240,000
27	H10	Southport, near New Orleans, La..........	American Creosote Wks.	New Orleans, La......	1901	1 1	84 108	172 172	17,557	2,275,000
28	H10	New Orleans, La......	New Orleans Wd. Pr. Co.	River & Lyon Sts., New Orleans, La.........	1888	1	72	125	3,535	460,000
29	G11	Slidell, La.............	Southern Creo. Co.....	Slidell, La.............	1879 1902	1 2	84 72	150 100	11,431	1,480,000
30	G10	Shreveport, La.........	Shreveport Creo. Co...	Amer. Creo. Co., Louisville, Ky............	1910	2	84	134	10,318	1,340,000
31	G10	Winnfield, La..........	Louisiana Creo. Co....	Winnfield, La.........	1906	1 1	72 72	126 80	5,825	755,000
32	G11	Bogalusa, La..........	Colonial Creo. Co.....	American Creosoting Co., Louisville, Ky..	1912	2	72	134	7,578	985,000
33	E11	Guthrie, Ky...........	L. & H. R. R. Co......	Louisville, Ky.........	1913	2	84	133	10,242	1,331,000
34	F11	Grenada, Miss.........	Ayer & Lord Tie Co...	Chicago, Ill...........	1904	4	74	128	15,308	1,990,000

For additional information see Part II.

SOUTHERN STATES (Continued).

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
35	G11	Gulfport, Miss........	Gulfport Creo. Co.....	Gulfport, Miss........	1906	2	84	120	9,240	1,210,000
36	G11	Gautier, Miss.........	L. & N. R. R. Co......	Louisville, Ky..........	1876 1903	1 2	72 72	119 115	9,870	1,285,000
37	F11	Louisville, Miss.......	American Creo. Wks..	New Orleans, La......	1912	1	108	172	10,939	1,415,000
38	F10	Argenta, Ark..........	Ayer & Lord Tie Co...	Chicago, Ill............	1907	4	74	132	15,788	2,050,000
39	F10	Texarkana, Ark.......	Int. Creo. & Con. Co...	Galveston, Tex........	1902	1 1	114 72	165 125	15,230	1,975,000
40	G10	Beaumont, Tex........	Int. Creo. & Con. Co...	Galveston, Tex........	1892 1897	1	108	140	8,905	1,155,000
41	F9	Denison, Tex..........	Mo., Kan. & Tex. Ry. Co. of Texas............	St. Louis, Mo.........	1909	4	72	108	12,216	1,585,000
42	F10	Texarkana, Tex.......	Nat. Lum. & Creo. Co.	Texarkana, Ark.......	1910	2	84	132	10,164	1,320,000
43	H9	Houston, Tex.........	Nat. Lum. & Creo. Co.	Texarkana, Ark.......	1912	4	72	120	13,574	1,765,000
44	H9	Houston, Tex.........	Tex. & N. O. R. R. Co..	Houston, Tex.........	1890	5	72	112	15,835	2,055,000
45	G9	Somerville, Tex.......	A., T. & S. F. R. R....	Topeka, Kan..........	1906	5	74	132	19,734	2,560,000
46	G9	Galveston, Tex........	Galveston Creo. Co....	Galveston, Tex........	1905	1	72	100	2,827	367,500
47	F9	Hugo, Okla..........	American Creo. Co.....	Louisville, Ky.........	1907	2	84	134	10,318	1,340,000

CENTRAL STATES.

48	C12	Toledo, Ohio..........	Federal Creo. Co......	Louisville, Ky.........	1909	3	84	134	15,477	2,000,000
49	C12	Toledo, Ohio..........	Jennison-Wright Co....	Toledo, Ohio..........	1910	2	72	130	7,352	955,000
50	C12	Orville, Ohio..........	Ohio Wood Pres. Co..	Pittsburgh, Pa.........	1912	1	84	90	3,465	450,000
51	D12	Cincinnati, Ohio.......	Comp. Wd. Pres. Co...	Cincinnati, Ohio.......	1909	1	72	76	2,150	280,000

For additional information see Part II.

CENTRAL STATES (Continued).

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
52	D11	Indianapolis, Ind......	Republic Creo. Co.....	Indianapolis, Ind......	1903	1	74	130	3,887	505,000
53	D11	Indianapolis, Ind......	American Creo. Co....	Louisville, Ky.........	1913	2	64	134	10,318	1.340,000
54	D11	Terre Haute, Ind......	Indiana Zinc-Creo. Co..	Terre Haute, Ind......	1904	2	72	120	6,787	880,000
55	D11	Terre Haute, Ind......	Chicago Creo. Co......	Chicago, Ill...........	1912	2	132	20	3,800	485,000
56	D11	Bloomington, Ind......	Indiana Creosoting Co.	Louisville, Ky.........	1907	1	84	134	5,159	670,000
57	D11	Columbus, Ind........	Indianapolis, Columbus & Southern Trac. Co.	Indianapolis, Ind......	1909	1	72	45	1,272	165,000
58	D11	Evansville, Ind........	Indiana Tie Co........	Evansville, Ind........	1907	2	72	110	6,220	810,000
59	C11	Waukegan, Ill.........	Chicago Creosoting Co.	Chicago, Ill...........	1907	2	72	134	7,578	985,000
60	D11	Carbondale, Ill........	Ayer & Lord Tie Co...	Chicago, Ill...........	1902	4 4	72 74	122 132	29,587	3,850,000
61	D11	Marion, Ill...........	American Creo. Co....	Louisville, Ky.........	1907	2	84	134	10,318	1.340,000
62	D10	Madison, Ill...........	Kettle River Co.......	Minneapolis, Minn.....	1909	4	84	135	20,790	2,700,000
63	C10	Galesburg, Ill..........	C., B. & Q. R. R......	Galesburg, Ill.........	1907	5	74	132	19,734	2,500,000
64	D11	Mt. Vernon, Ill........	T. J. Moss Tie Co......	St. Louis, Mo.........	1899	1 1	74 72	132 117	7,255	940,000
65	D11	Metropolis, Ill........	Joyce-Watkins Co.....	Chicago, Ill...........	1913	1	74	100	2,982	388,000
66	E11	Joppa, Ill.............	Indiana Tie Co........	Evansville, Ind........	1909	2	72	110	6,220	810,000
67	B12	Bay City, Mich........	Michigan Pipe Co.....	Bay City, Mich........	1893	1	72	42	1,188	155,000
68	A11	Escanaba, Mich........	Chi. & N. W. Ry. Co...	Chicago, Ill...........	1903	3	72	112	9,472	1,230,000
69	B11	Reed City, Mich.......	Michigan Wood Preserving Co..........	Pittsburgh, Pa.........	1913	1	90	90	3,977	517,000

For additional information see Part II.

CENTRAL STATES (Continued).

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
70	A10	Minneapolis, Minn.....	Republic Creo. Co.....	Minneapolis, Minn.....	1905	2	74	130	7,774	1,010,000
71	A10	Sandstone, Minn.......	Kettle River Co.......	Minneapolis, Minn.....	1904	2	72	120	6,787	880,000
72	A10	Brainerd, Minn........	Northern Pacific Ry...	St. Paul, Minn........	1907	2	84	134	10,318	1,340,000
73	E10	Springfield, Mo........	American Creo. Co....	Louisville, Ky.........	1907	2	84	134	10,318	1,340,000
74	D10	Kansas City, Mo.......	American Creo. Co....	Louisville, Ky.........	1907	2	84	134	10,318	1,340,000
75	D9	Topeka, Kan..........	Union Pacific R. R. Co.	Omaha, Neb..........	1909	2	73	117	6,800	885,000

ROCKY MOUNTAIN AND PACIFIC STATES.

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
76	A6	Somers, Mont.........	Great Northern Ry. Co.	St. Paul, Minn........	1901	4	72	110	12,442	1,610,000
77	A6	Paradise, Mont.........	Northern Pac. Ry. Co..	St. Paul, Minn........	1907	2	84	134	10,318	1,340,000
78	A6	Butte, Mont...........	Anaconda Cop. Min. Co.	Butte, Mont...........	1910	1	72	43	1,216	160,000
79	B7	Sheridan, Wyo........	C., B. & Q. R. R........	Chicago, Ill...........	1899	2	74	132	7,894	1,025,000
80	C7	Laramie, Wyo.........	Union Pacific R. R....	Omaha, Neb...........	1903	2	73	117	6,800	885,000
81	A5	Kellogg, Idaho.........	Bunker Hill & Sullivan Mining Co............	Kellogg, Idaho.........	1908	1	84	10	385	50,000
82	A4	Tacoma, Wash........	St. P. & Tacoma Lum..	Tacoma, Wash........	1912	1	84	130	5,005	650,000
83	A4	Yardley, Wash........	Western Wd. Pres. Co.	Spokane, Wash........	1912	1	84	65	2,502	325,000
84	A4	Lowell, Wash..........	Puget Sd. Wd. Pres. Co.	Lowell, Wash.........	1895	1 1 1	84 72 72	117 83 52	8,322	1,080,000
85	A4	Seattle, Wash.........	J. M. Colman Co......	Seattle, Wash.........	1884 1912	3	75	120	11,043	1,430,000

For additional information see Part II.

ROCKY MOUNTAIN AND PACIFIC STATES (Continued).

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
86	A4	Eagle Harbor, Wash..	Pacific Creosoting Co..	Eagle Harbor, Wash...	1906	8	73	125	29,060	3,770,000
87	A4	Wyeth, Ore............	Oregon-Washington R. R. and Nav. Co.....	Portland, Ore.........	1904	4	72	114	12,995	1,690,000
88	A4	St. Helens, Ore........	St. Helens Creo. Co...	St. Helens, Ore........	1912	4	84	136	20,944	2,720,000
89	B4	Latham, Ore..........	Southern Pac. R. R...	San Francisco, Cal.....	1893	2	72	112	6,334	825,000
90	A4	Burlington (near Portland), Ore...........	Columbia Creo. Co....	Portland, Ore.........	1912	1	7	65	1,838	240,000
91	F7	Alamogordo, N. Mex..	El Paso & S.W.R.R.Co.	El Paso, Tex..........	1902	2	72	106	5,995	780,000
92	E7	Albuquerque, N. M....	A., T. & S. F. Ry. Co...	Topeka, Kan..........	1908	2	74	132	7,894	1,025,000
93	F7	Cimarron, N. M.......	Continental Tie & Lumber Co.............	Denver, Col...........	1913	1	84	87	3,350	435,000
94	D4	Oakland, Cal..........	Southern Pacific Ry....	San Francisco, Cal.....	1889	1 1	72 72	108 138	6,956	900,000
95	F5	Los Angeles, Cal......	Southern Pacific Ry...	San Francisco, Cal.....	1907	2	72	112	6,334	825,000
96	F5	San Pedro, Cal........	S. P. L. A. & S. L. R.R.	Los Angeles, Cal......	1908	2	72	117	6,617	860,000
					Grand Total...............					111,019,500

CANADA.

Plant No. Reference.	Map Reference.	Location.	Managing Company.	Address.	Year built.	No. of Cyl.	Dia., inches.	Length, ft.	Volume, cu. ft.	Capacity per an. 6 in. x 8 in. 8 ft. ties
97	A11	Fort Francis, Ont.....	Alex. Bruce & Co......	Glasgow, Scotland.....	1912	1	84	76	2,926	380,000
98	A9	Transcona, near Winnipeg, Man..........	Dominion Tar and Chem. Co., Ltd......	Sydney, N. S..........	1912	1 3	78 78	84 135	16,225	2,110,000
99	A16	Sydney, N. S..........	Dominion Tar and Chem. Co., Ltd......	Sydney, N. S..........	1911	1	78	85	2,821	366,000
100	B13	Trenton, Ont..........	Canada Creo. Co., Ltd..	Toronto, Can..........	1913	1	84	134	5,159	670,000
101	A4	Vancouver, B. C.......	Dominion Creosoting Co., Ltd.............	Vancouver, B. C.......	1910	2	90	100	5,340	824,000
					Grand Total.................					4,340,000

For additional information see Part II.

PART Ia.

LIST OF WOOD-PRESERVING PLANTS IN THE UNITED STATES, CANADA AND MEXICO, JANUARY 1, 1915.

OPEN TANK OR NON-PRESSURE PROCESSES.

Plant No. Reference.	Location.	Managing Company.	Address.	Year built.	No. of tanks or boilers.	Size.
		EASTERN STATES.				
1a	Lowell, Mass.........	Otis, Hillen & Son.....	Lowell, Mass..........	1848	2	4 ft. x 8 ft. x 50 ft.
2a	Portsmouth, N. H.....	Otis, Hillen & Son.....	Lowell, Mass..........	1875	4	4 ft. x 8 ft. x 50 ft.
3a	Newark, N. J.........	Public Service Ry.....	Newark, N. J.........	1909	1	10 ft. x 32 ft. x 2 ft.
4a	Nanticoke, Pa.........	Del., Lack. & West. R. R. Coal Mining Dept.	Scranton, Pa..........	1907	1	6 ft. dia. x 32 ft.
5a	New Philadelphia, Pa..	Phila. & Reading Coal & Iron Co..........	Pottsville, Pa.........	1908	1	6 ft. dia. x 32 ft.
		SOUTHERN STATES.				
6a	New Orleans, La......	Reeves Co.............	New Orleans, La......	1910	1	4 ft. x 4 ft. x 30 ft.
7a	Mobile, Ala...........	Republic Creosoting Co.	Mobile, Ala...........	1912	1	3 ft. x 19 ft. x 10 ft.
		CENTRAL STATES.				
8a	Keokuk, Iowa.........	U. S. Wood Pres. Plant	Keokuk, Iowa.........	1908	1	4 ft. x 3 ft. x 42 ft.
9a	Milan, Ill..............	U. S. Wood Pres. Plant	Milan, Ill..............	1908	1	4 ft. x 3 ft. x 42 ft.
10a	Chicago, Ill...........	Naugle Pole & Tie Co.	Chicago, Ill...........	1912	2	5 ft. x 5 ft. x 10 ft.
11a	Stillwater, Minn.......	U. S. Wood Pres. Plant	Stillwater, Minn.......	1908	1	4 ft. x 3 ft. x 42 ft.
12a	Minneapolis, Minn.....	Page & Hill Co........	Minneapolis, Minn.....	1911	4	6 ft. x 11 ft.
13a	Fountain City, Wis....	U. S. Wood Pres. Plant	Fountain City, Minn...	1908	1	4 ft. x 3 ft. x 42 ft.
14a	Milwaukee, Wis.......	Milwaukee Ry. & Light Co.	Milwaukee, Wis.......	1910		

For additional information see Part IIa.

CENTRAL STATES (Continued).

Plant No. Reference.	Location.	Managing Company.	Address.	Year built.	No. of tanks or boilers.	Size.
15a	Cleveland, Ohio	Cityo Cleveland	Cleveland, Ohio	1909	1	4 ft. x 3½ ft. x 42 ft.
16a	Lead, S. D.	Homestake Mining Co.	Lead, S. D.	1908	1	4 ft. dia. x 38 ft.
17a	Kansas City, Mo.	J. Deere Plow Co.	Kansas City, Mo.			

ROCKY MOUNTAIN AND PACIFIC COAST STATES.

Plant No. Reference.	Location.	Managing Company.	Address.	Year built.	No. of tanks or boilers.	Size.
18a	Portland, Ore.	Carboleum W. P. Co.	Portland, Ore.	1910	4	3 ft. x 4 ft. x 60 ft.
19a	Portland, Ore.	Barnes-Lindsey Mfg. Co.	Portland, Ore.			
20a	Spokane, Wash.	Carboleum Treating & Paving Co.	Spokane, Wash.	1910	1	3 ft. x 4 ft. x 60 ft.
21a	Lowell, Wash.	Puget Sound W. P. Co.	Lowell, Wash.	1895	1	3 ft. x 10 ft. x 30 ft.
22a	Butte, Mont.	Anaconda Cop. Min. Co.	Butte, Mont.	1909	1	10 ft. x 10 ft. x 10 ft.
23a	Priest River, Idaho	Lindsley Bros.	Spokane, Wash.	1912	1	6 ft. dia. x 12 ft.
24a	Priest River, Idaho	Lindsley Bros.	Spokane, Wash.	1910	1	16 ft. x 10 ft. x 2 ft.
25a	Naskup, B. C.	Lindsley Bros.	Spokane, Wash.	1910	1	6 ft. dia. x 12 ft.
26a	Fresno, Cal.	San Joaquin Light & Power Co.	Fresno, Cal.	1910	2	7 ft. x 9 ft. x 9 ft.
27a	San Miquel, Cal.	San Joaquin Light & Power Co.	Fresno, Cal.	1910	1	7 ft. x 9 ft. x 9 ft.
28a	Los Angeles, Cal.	Pacific Light & Power Co.	Los Angeles, Cal.	1912		
	Los Angeles, Cal.	Weir & Jordan	Los Angeles, Cal.	1911		
30a	Oakland, Cal.	Southern Pac. Ry. Co.	San Francisco, Cal.	1889	1	4 ft. x 6 ft. x 8 ft.

For additional information see Part IIa.

PART II.

EASTERN STATES.

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
1	C14	103 108 115 119 134 135 136	200 201 202 203 204 205 210	Creosote	A	Yes	
2	B14	105 107 111 116 117 126 127 134 135 136	200 204	Creosote	A	No	
3	C14	116 117 134 135 136	200 201 203 204	Creosote	A	Yes	
4	C14	134 135 136	200 201 203 204	Creosote	A	Yes	
5	C14	115 116 117 119 127 134 135 136	200 201 203 204 210	Creosote	A	No	
6	C14	100 103 106 115 116 117 134 135 136 159	200 201 202 203 204 205 207 208 210	Creosote Wat'r Gas Tar	A and B	Yes	
7	C13	115 116 117 118 122 124 125 126 127 132 134 135 136 137 138 140 141 142 144 148	200 201 203 204	Creosote	A	No	
8	C13	105 107 111 116 117 126 127 131 134 135 136 144	200 201 203 204 205 207 208 209 210 211	Creosote	A and D	No	
9	C13	105 107 111 117 126 127 134 135 136	200 201 202 203 204 205 207 208 209 210 211	Creosote	A and D	No	
10	C13	115 116 117 118 119 125 126 127 135 136	200 201 203 208 210	Creosote	A, B and D	Yes	
11	C13	105 116 117 118 119 123 125 126 127 131	200 204 210 212	Creosote	A	No	

EASTERN STATES (Continued)

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
12	E13	131 134 135 136 144	208	Creosote	A	Yes	Treat Paving Blocks
13	E13	131 134 135 136 137 139 141 144	200 201 202 203 204 205 207 209 210	Creosote	A and B	Yes	
14	E13	134 135 136 137 144 145	200 201 202 203 204 205 207 209 210	Creosote	A and B	Yes	
15	E13	134 135 136	200 201 202 203 204 205 207 208 209 210	Creosote	A	Yes	
16	D13	116 117 124 125 126 127 133 137 142	200 204	Creosote Chl. of Zinc	A, B and E	No	

SOUTHERN STATES.

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
17	H12	134 135 136	200	Creosote	A	No	
18	G11	134 135 136	200 201 202 203 204 205 206 207 208 210	Creosote	A	Yes	
19	G12	134 135 136	200 201 202 203 204 205 207 208 210	Creosote	A	Yes	
20	G12	134 135 136 143	200 201 203 204 207 210	Creosote	A and D	Yes	
21	G12	121 134 135 136 144	200 201 202 203 204 210	Creosote Chl. of Zinc	A and D	No	
22	F12	117 134 135 136 137	200 202 203 204 205 207 208	Creosote	A	Yes	
23	G12	121 134 135 136	200 201 203 204 205 210	Creosote Chl. of Zinc	A, B, D & E	Yes	Under Construction

SOUTHERN STATES (Continued).

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
24	F11	134 135 136	200 201 202 203 204 207 208	Creosote	A	Yes	
25	G11	134 135 136 137 141 142 144	200 201 202 203 204 205 206 207 208 210	Creosote	A	Yes	
26	F11	134 135 136	200 202 203 207	Creosote	A	No	
27	H10	134 135 136 137 144 145	200 201 202 203 204 205 207 208 210	Creosote	A and D	Yes	
28	H10	134 135 136	200 201 202 203 204 205 207	Creosote	A and D	Yes	
29	G11	134 135 136 143	200 201 202 203 204 205 206 207 208 209 210	Creosote	A and B	Yes	
30	G10	134 135 136 137 142	200 201 202 203 204 210	Creosote	A	Yes	
31	G10	134 135 136 137 145	200 201 202 203 205	Creosote	A and B	Yes	
32	G11	134 135 136 137 142	200 201 203 204 210	Creosote	A	Yes	
33	E11	137	200	Creosote Chl. of Zinc	A and B	No	
34	F11	134 135 136 137 143 144	200 201 202 203 204 207 208 210	Chl. of Zinc Creosote	A, B and D	Yes	
35	G11	134 135 136	200 201 202 203 204 205 207 208 210	Creosote	A, B and D	Yes	
36	G11	134 135 136	201 202 203 204 205 207 208 209 211 212	Creosote	A and B	No	

SOUTHERN STATES (Continued).

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
37	F11	134 135 136 137 144 145	200 201 202 203 204 205 207 208 210	Creosote	A and D	Yes	
38	F10	116 117 124 125 127 128 131 134 135 136 137 140 142 144	200 201 202 203 204 208 210	Creosote Chl. of Zinc	A, B and D	Yes	
39	F10	134 135 136 137	200 201 202 203 204 205 206 207 208 210	Creosote Chl. of Zinc	A and B	Yes	
40	G10	134 135 136 137	200 201 202 203 204 205 206 207 208 210	Creosote Chl. of Zinc	A and B	Yes	
41	F9	123 130 134 135 136 140 141 142 143 144 145 146 147 148 150 153	200 201 203 204 205 207 210	Creosote	A and D	No	
42	F10	116 117 134 135 136 137 142 144 145	200 201 202 203 204 207 208 210	Creosote Chl. of Zinc	A, B, D & E	Yes	
43	H9	134 135 136 137 142 144 145	200 201 202 203 204 205 207 208 210	Creosote Chl. of Zinc	A, B and D	Yes	
44	H9	134 135 136	200 201 203 204 211	Creosote Chl. of Zinc	A and B	No	
45	G9	115 117 125 131 132 134 135 136 137 141 144 145 148	200 201 203 204 210	Creosote	A and D	No	
46	G9	134 135 136	200 201 202 203 204 205 210	Creosote	A	Yes	
47	F9	134 135 136 137 138 142 144 145 148	200 201 203 204	Creosote	A	No	

CENTRAL STATES.

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
48	C12	105 116 117 124 125 126 127	200 201 203 204 210	Creosote	A	No	
49	C12	102 105 106 107 109 110 111 112 113 116 117 118 120 124 125 126 127 128 131 134 135 136	200 201 202 203 204 205 207 208 210	Creosote Chl. of Zinc	A and B	Yes	
50	C12	115 116 117 127 126 127 135 136	200 204	Creosote	A, B and D	Yes	
51	D12	115 116 117 127 134 135 136 141 142	200 203 204 208	Creosote Crude Oil	A	Yes	
52	D11	134 135 136 137 141	200 203 204 205 207 208 210	Creosote Chl. of Zinc	A	Yes	
53	D11	116 117 118 124 125 126 127 131 132	200 201 203 204	Creosote	A	Yes	
54	D11	116 117 125 126 127 134 135 136 159	200 201 203 204 205	Creosote Chl. of Zinc	A, B and E	Yes	
55	D11	134 135 136 208	208	Chl. of Zinc Creosote	A	Yes	For paving blocks only
56	D11	116 117 118 119 124 125 126 127	200 201 202 203 204 208 210	Creosote	A	Yes	
57	D11	116 117 118 119 121 122 123 124 126 127 131 132 133	200 202 203 204 205 207 210	Creosote	A	No	
58	D11	116 117 118 122 124 125 126 127 131 132 133 144	200	Chl. of Zinc Creosote	A and B	Yes	

CENTRAL STATES (Continued).

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
59	C11	106 107 110 111 117 126 127 134 135 136 137	200 201 203 204 208	Creosote Chl. of Zinc	A, B and C	Yes	
60	D11	115 116 117 118 119 124 125 127 131 132	200	Creosote Chl. of Zinc	A, B and D	Yes	
61	D11	127 134 135 136 137 142 144 145 148	200 201 202 203 204 208 210	Creosote	A	Yes	
62	D10	116 117 119 125 126 127 128 132 133 134 135 136 137 142 143 154 157 159	200 201 202 203 204 205 206 207 208 209 210	Creosote Chl. of Zinc	A, B, C & E	Yes	
63	C10	105 106 107 110 111 112 116 117 118 119 120 122 123 124 125 126 127 129 130 131 132 133 134 135 136 137 138 140 142 143 144 148 159	200 201 203 204 208 209 210	Creosote Chl. of Zinc	A, B and E	No	
64	D11	116 117 118 124 125 126 127 131 134 135 136	200 201 204	Creosote Chl. of Zinc	A, B and E	Yes	
65	D11	116 117 118 120 123 124 125 126 127 128 136 138 140 142 143 144 145 146 150	200	Creosote Chl. of Zinc	A, B, D & E	Yes	
66	E11	116 117 118 122 124 125 126 127 131 132 133 144	200	Creosote Chl. of Zinc	A and B	Yes	
67	B12	101 102 105 106 107 110 111	203 210	Creosote	A	Yes	
68	A11	105 106 107 110 111	200 201 203 204	Creosote Chl. of Zinc	A, B and E	No	
69	B11	107 110 111	200 201 203 208 210	Creosote Chl. of Zinc	A, B and D	Yes	

CENTRAL STATES (Continued).

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
70	A10	100 101 102 103 106 110 111 113 134 135 136 154 159 160 172	200 201 202 203 204 207 208 210	Creosote	A	Yes	
71	A10	100 101 102 103 104 105 107 110 111	200 201 204	Creosote Chl. of Zinc	A, B and C	Yes	
72	A10	102 105 110 111 116 117	200 203 204 208 212	Creosote	A	No	
73	E10	116 117 124 125 126 127 134 135 136 145	200 201 203 204	Creosote	A	No	
74	D10	116 117 125 127 134 135 136	200 201 203 204	Creosote	A	No	
75	D9	116 117 125 127 134 135 136	200 201 203 204	Chl. of Zinc	A and B	No	

ROCKY MOUNTAIN AND PACIFIC COAST STATES.

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
76	A6	100 103 110 151 152 154 159 161 166 172	200 203 204 208	Chl. of Zinc	A and B	No	
77	A6	151 154 157 165 172	200 203 212	Creosote	A	No	
78	A6	151 154 159	200 204 206	Creosote	A	No	
79	B7	102 103 106 110 159	200	Chl. of Zinc	A and B	No	
80	C7	102 103 106 110 159	200	Chl. of Zinc	A and B	No	
81	A5	159 160 161 162	206	Creosote	A	No	

ROCKY MOUNTAIN AND PACIFIC COAST STATES (Continued).

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
82	A4	159 171	200 201 202 203 204 205 206 207 208	Creosote	A and C	Yes	
83	A4	159 161 162	200 201 202 203 204 210	Creosote	A	Yes	
84	A4	159 161 165 166 171	200 201 202 203 204 205 208 210	Creosote	A, B and C	Yes	
85	A4	159	200 201 203 204 208 210	Creosote	A and B	Yes	
86	A4	159	200 201 203 204 205 207 208 209 210	Creosote	A and C	Yes	
87	A4	159	200 201 203 204 208	Creosote Chl. of Zinc	A and C	No	
88	A4	159	200 201 202 203 204 210	Creosote	A and C	Yes	
89	B4	159	200 201 202 203 204 208	Creosote Chl. of Zinc	A, B and C	No	
90	A4	159 165	200 204 205 207 208 209 210	Creosote	A, B and C	Yes	
91	F7	101 151 154	200	Creosote	A and D	No	
92	E7	151 152 154 157	200 201 203 204 210	Crude Oil Creosote	A and C	No	
93	F7	151	200 203 204	Creosote Chl. of Zinc	A, B and D	Yes	
94	D4	159	200 201 203-204 205 208 209 210	Creosote Chl. of Zinc	A, B and C	No	
95	F5	159	200 204	Chl. of Zinc	A and B	No	
96	F5	159	200 201 203 204	Creosote Chl. of Zinc	A, B and C	Yes	

PART IIa.

OPEN-TANK PLANTS.

EASTERN STATES.

Plant No. Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative.	Process.	Commercial Works.	Remarks.
1a	101 102 103 106 107	200 201 203 207 210	Chlo. of Merc.	Immer. cold	Yes	"Kyanizing" process
2a	101 102 103 106 107	200 201 203 207 210	Chlo. of Merc.	Immer. cold	Yes	"Kyanizing" process
3a	134 135 136	200	Carbolineum	Immer. hot	No	Conveyor chain type of open-tank process
4a	101 102 103 106 108 134 135 136	200 202 203 204 205 206 207 208	Creosote	Boiling	No	
5a	134 135 136	206	Chlo. of Zinc. Creosote	Boiling	No	

SOUTHERN STATES.

Plant No. Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative.	Process.	Commercial Works.	Remarks.
6a	134 135 136	200	Creosote	Boiling	No	
7a	134 135 136	202	Creosote	Immer. hot	No	

CENTRAL STATES.

Plant No. Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative.	Process.	Commercial Works.	Remarks.
8a	134 135 136 143 159	203	Creosote	Immer. hot	No	
9a	134 135 136 143 159	203	Creosote	Immer. hot	No	
10a	113 160	202	Creosote Carbolineum	Immer. hot	Yes	For butts of poles only
11a	134 135 136 143 159	203	Creosote	Immer. hot	No	
12a	113 160	202	Creosote	Immer. hot	Yes	For butts of poles only
13a	134 135 136 143 159	203	Creosote	Immer. hot	No	

CENTRAL STATES (Continued).

Plant No. Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative.	Process.	Commercial Works.	Remarks.
14a	151	200 201 203 205	Creosote	Immer. hot	No	
15a	134 135 136	204 208 210	Creosote	Boiling	No	
16a	151	200 201 203 205 210	Creosote	Boiling	No	
17a	134 135 136	200 203	Creosote	Boiling	No	

ROCKY MOUNTAIN AND PACIFIC COAST STATES.

Plant No. Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative.	Process.	Commercial Works.	Remarks.
18a	159	200 202 203 208	Carbolineum	Boiling	Yes	
19a	159 160 161	202 203	Creosote	Boiling	Yes	
20a	159 160 161	200 202 203	Carbolineum	Boiling	Yes	
21a	159 160 161	202	Creosote	Boiling	Yes	For butts of poles only
22a	159 160	202 206	Creosote	Boiling	No	
23a	159 160 161	202	Carbolineum Creosote	Boiling	Yes	For butts of poles only
24a	159 160 161	200	Creosote	Immer. hot	Yes	For ties
25a	159 160 161	202	Carbolineum Creosote	Boiling	Yes	For butts of poles only
26a	160 161	202	Creosote	Boiling	No	For butts of poles only
27a	160 161	202	Creosote	Boiling	No	For butts of poles only
28a	160 161	200 202	Creosote	Boiling	No	
29a	159 160 161	200 201 202	Creosote	Boiling	Yes	
30a	159 170 171	202	Creosote	Boiling	No	For butts of poles only

CANADA.

Plant No. Reference.	Map Reference.	Kinds of Wood Treated.	Kind of Material Treated.	Preservative Used.	Plant Equipped to Treat by Process.	Commercial Works.	Remarks.
97	A11	101 102 103 104 105 106 107 108 110 111 112	200 201 203 204 210	Chl. of Zinc Alum. Sul.	A and B	Yes	Bruening-Marmetschke process
98	A9	101 102 103 104 105 106 107 108 110 111 112	200 201 203 204 210	Creosote	A and B	Yes	
99	A16	101 102 103 104 105 106 107 108 110 111 112	200 201 203 204 210	Creosote	A and B	Yes	
100	B13	101 105 107 111 134	200 203 204 208	Creosote	A	Yes	
101	A4	159 160 161 162	200 201 204	Creosote	A, B and C	Yes	

MEXICO.

Have no data regarding treating plants in Mexico. The Mexican Central Railroad built a plant at Aguas Calientas, Mexico (K8), in 1901 to treat railroad ties with chloriue of zinc. About the year 1907 the Madero Company built a 2-cylinder plant at Maderoa, Chihuahua, Mexico (H7), to treat railroad ties with chloride of zinc.

LIST OF UNITED STATES PATENTS ON WOOD-PRESERVATION.*

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Henry Aitken, Darroch, Falkirk, Scotland.	Preserving timber.	352,216	Nov. 9, 1886
Hugo Akerheilm, Chicago, Ill.	Improvement in compositions for preserving wood.	185,058	Dec. 5, 1876
August, Allen Case Co., Michigan.	Improved method of preventing decay in the timbers of bridges, buildings, etc.	106,647	Aug. 23, 1870
Edw. R. Andrews, New York, N. Y.	Composition for preserving wood.	247,234	Sept. 20, 1881
W. C. Andrews, New York, N. Y.	Vulcanizing wood.	430,055	June 10, 1890
Philip F. Apfel, Seattle, Wash., and Ralph L. Earnest, Portland, Ore.	Protecting piles against worms, etc.	883,507	March 31, 1908
Oliver App, Blue Mound, Ill.	Improvement in composition for preserving wood.	219,377	Sept. 9, 1879
R. W. Archer, Corpus Christi, Texas.	Improvement in process for preserving wood.	153,515	July 28, 1874
McKenzie Arnn, Bristol, Va.	Composition for coloring and preserving wood.	601,767	April 5, 1898
McKenzie Arnn, Bristol, Va.	Wood-preserving compound.	633,778	Sept. 26, 1890
Charles Arnoudts, Seattle, Wash.	Composition for preserving piles from teredo, etc.	526,552	Sept. 25, 1894
Max Bachert, New York, N. Y.	Apparatus for saturating wood.	666,915	Jan. 29, 1901
Max Bachert, New York, N. Y., and D. W. O'Neill, Newark, N. J.	Preserved wood and process of preparing same.	602,713	April 19, 1898
Thurman Bailey, Bridport, Vt.	Improvement in processes for preparing wood for roofing.	125,251	April 2, 1872
James J. Barr, Slidell, La.	Automatic retort cover.	857,148	June 18, 1907
James R. Brate, Cincinnati, Ohio.	Process of preserving wood.	522,284	July 3, 1894
Frank Batter, Marshfield, Ore.	Apparatus for preserving piles.	452,513	May 19, 1891
J. H. Bauer, Scranton, Pa.	Improvement in processes for treating sounding-boards.	149,426	April 7, 1874
S. Beer, New York, N. Y.	Improved process for seasoning and preserving wood.	73,565	Jan. 21, 1868
Andries Bevier, New York, N. Y.	Method of preserving wood.	681,032	Aug. 20, 1901
V. W. Blanchard, Bridport, Vt.	Improved mode of preserving wood.	94,704	Sept. 14, 1869

*From "Preservation of Structural Timber," by Howard F. Weiss.

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Guido Blenio, New York, N. Y.	Process for fireproofing wood.	779,761	Jan. 10, 1905
A. T. Bleyley, Conception, Mo.	Improvement in process for preserving burial cases, etc.	175,329	March 28, 1876
H. H. Blodgett, Omaha, Neb.	Wood-preserving composition.	606,702	July 5, 1898
John B. Blythe, Bordeaux, France.	Treating railway sleepers.	313,912	March 17, 1885
John B. Blythe, Bordeaux, France.	Apparatus for treating, seasoning and preserving timber.	313,913	March 17, 1885
John Borner, Rahway, N. J.	Apparatus for impregnating wood.	703,522	July 1, 1902
S. B. Boulton, Cooped Hall, County of Hertford, Eng.	Treating timber with preservative fluids.	247,602	Sept. 27, 1881
S. B. Boulton, London, Eng.	Method of preserving timber.	360,947	April 12, 1887
Edmond Bouvier, Pensacola, Fla.	Improvement in solutions for preserving timber.	218,659	Aug. 19, 1879
Joachin Brenner, Gainfarn, Austria-Hungary.	Process of dyeing wood.	755,993	March 29, 1904
Jas. P. Bridge, Boston, Mass.	Improved compound for preserving wood, leather, etc.	86,808	Feb. 9, 1869
Robert E. Bright, Grenada, Miss.	Apparatus for treating timber.	887,583	May 12, 1908
H. R. Brinkerhoff, Oakpark, Ill.	Waterproofed wood and method of making same.	686,582	Nov. 12, 1901
Albert Brisbane, New York, N. Y.	Improvement in processes for treating wood for paving and other purposes.	155,788	Oct. 13, 1874
William Brisley and William S. Finch, Toronto, Canada.	Composition for preserving wood.	359,384	March 15, 1887
Charles Brown, Albemarle Co., Va.	Improved process of preserving timber from decay.	83,758	Nov. 3, 1868
Samuel P. Brown, Washington, D. C.	Improvement in preserving wood.	115,931	June 13, 1871
W. C. Bruson, Chicago, Ill.	Compound for preserving wood.	251,346	Dec. 27, 1881
Walter Buehler, Minneapolis, Minn.	Preserving wood.	899,237	Sept. 22, 1908
Walter Buehler, Minneapolis, Minn.	Preserving wood.	899,480	Sept. 22, 1908
Wm. W. Bunnell, Thomasville, Neb.	Compound for preserving wood.	238,341	March 1, 1881

List of United States Patents on Wood-Preservation (Continued.)

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Peter Grant Burns, St. Louis, Mo.	Wood-preserving apparatus.	864,092	Aug. 20, 1907
Rudolph G. Burstenbinder, Hamburg, Germany.	Preservation of wood.	266,092	Oct. 17, 1882
Jas. J. Byers, Gulfport, Miss.	Wood saturating and coating apparatus.	858,950	July 2, 1907
Samuel Cabot, Jr., Boston, Mass.	Improvement in processes for preserving wood.	184,141	Nov. 7, 1876
Samuel Cabot, Brookline, Mass.	Compound for bleaching and preserving wood.	515,191	Feb. 20, 1894
James Calkins, New York, N. Y.	Improvement in preserving wood.	78,514	June 2, 1868
Joseph P. Card, St. Louis, Mo.	Preserving wood.	254,274	Feb. 28, 1882
Joseph P. Card, St. Louis, Mo.	Process of preserving wood.	317,440	May 5, 1885
J. P. Card, Chicago, Ill.	Solution for preserving.	419,582	Jan. 14, 1890
Joseph B. Card, Chicago, Ill.	Method of preserving wood.	815,404	March 20, 1906
C. S. Chamberlain, Oakland, Cal.	Wood-preserving apparatus.	621,774	March 21, 1899
Octave Chanute, Kansas City, Mo.	Preserving timber structures.	430,068	June 10, 1890
Octave Chanute, Chicago, Ill.	Process of preserving wood.	688,932	Dec. 17, 1901
S. B. Chapman, Abbeville, Ga.	Solution for preserving timber.	764,913	July 12, 1904
Sidney B. Chapman, Skyland, N. C.	Treated wood and process of producing the same.	839,551	Dec. 25, 1906
Louis Chatman, Washington, D. C.	Drying apparatus.	766,340	Aug. 2, 1904
Emile Chevigny,	Composition of matter for painting and preserving wood.	824,794	July 3, 1906
Wm. B. Chisholm, Charleston, S. C.	Preservation of wood.	802,680	Oct. 24, 1905
Charles E. Clarke, George Hadley and J. C. Clifford, Buffalo, N. Y.	Improved mode of preserving wood.	67,104	July 23, 1867
E. W. Clark, Hartford, Conn.	Improved solution for treatment of wood.	94,869	Sept. 14, 1869
Seth L. Cole, Brooklyn, N. Y.	Improvement in preserving wood.	124,419	March 12, 1872
Seth L. Cole, Brooklyn, N. Y.	Improvement in processes of preserving wood.	124,420	March 12, 1872

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Edw. Z. Collings, Camden, N. J.	Apparatus for preserving wood.	310,880	Jan. 20, 1885
Edw. Z. Collings, Camden, N. J.	Method of preserving wood.	318,730	May 12, 1885
Joseph H. Connelly, Allegheny, Pa.	Preserved wood.	243,062	June 21, 1881
Silas Constant, Peekskill, N. Y., and John Smith, Brooklyn, N. Y.	Improvement in seasoning and preserving wood.	65,545	March 17, 1867
Silas Constant, Peekskill, N. Y., and John Smith, Brooklyn, N. Y.	Improvement in seasoning and preserving wood.	116,274	June 27, 1871
George C. Cowles, Bay Mills, Mich.	Undressed lumber and process of preserving same.	746,678	Dec. 15, 1903
E. L. Cowling, Boston, Mass.	Improvement in preserving wood.	84,733	Dec. 8, 1868
C. M. Cresson, Philadelphia, Pa.	Improvement in preserving wood.	79,554	July 7, 1868
C. M. Cresson, Philadelphia, Pa.	Improvement in seasoning and preserving wood.	109,872	Dec. 6, 1870
C. M. Cresson, Philadelphia, Pa.	Improvement in seasoning and preserving wood.	109,873	Dec. 6, 1870
Wm. Cross, Brisbane, Queensland.	Method of preserving timber.	643,762	Feb. 20, 1900
W. G. Curtis and J. D. Isaacs, San Francisco, Cal.	Process of preserving timber.	545,222	Aug. 27, 1895
W. G. Curtis and J. D. Isaacs, San Francisco, Cal.	Process of preserving wood.	11,515	Dec. 3, 1895
A. R. Davis, Cambridge, Mass.	Improved process of treating wood for covering walls.	74,056	Feb. 4, 1868
Edw. Davis, Redondo, Cal.	Pliable-flange pile casing.	464,960	Dec. 15, 1891
J. C. Day, Hackettstown, N. J.	Improvement in seasoning and preserving wood.	100,380	March 1, 1870
J. A. Deghuee, New York, N. Y.	Method of preserving and waterproofing wood.	802,739	Oct. 24, 1905
E. J. De Smedt, New York, N. Y.	Improved composition for preserving timber and wood.	100,608	March 8, 1870
B. H. Detwiler and S. G. van Gilder, Williamsport, Pa.	Improvement in preserving wood.	111,045	Jan. 17, 1871
Fred Dixon, London, England.	Improvement in processes for treating wood.	181,651	Aug. 29, 1876
B. V. B. Dixon and J. P. Card, St. Louis, Mo.	Preserving wood.	239,033	March 22, 1881

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
John Dolbeer, San Francisco, Cal.	Apparatus for steaming piles.	333,204	Dec. 29, 1885
H. C. Dorr, San Francisco, Cal.	Compound for preserving wood.	293,955	Feb. 19, 1884
C. J. Doyle, Philadelphia, Pa.	Apparatus for preserving wood.	645,793	March 20, 1900
J. A. Draper, Shaftsburg, Vt.	Improvement in compounds for preserving wood.	152,620	June 30, 1874
Wm. Dripps, Coatesville, Pa.	Improved process of restoring and preserving decaying railroad ties.	96,405	Nov. 2, 1869
P. H. Dudley, New York, N. Y.	Apparatus for impregnating wood.	381,682	April 24, 1888
P. H. Dudley, New York, N. Y.	Preserving railway ties.	406,566	July 9, 1889
Firmin Dufourie, New York, N. Y.	Improvement in processes for preserving wood.	150,841	May 12, 1874
P. F. Dundon, San Francisco, Cal.	Timber-treating process.	753,052	Feb. 23, 1904
Chas. J. Eames, New York, N. Y.	Improvement in processes for preserving wood.	134,133	Dec. 24, 1872
Edw. Earle, Savannah, Ga.	Improvement in the mode of preserving timber.	934	Sept. 20, 1838
H. F. Eckert, San Francisco, Cal.	Apparatus for preserving timber.	509,724	Nov. 28, 1893
H. L. Eddy, Geneva, N. Y.	Improved method of preserving wood.	53,217	March 13, 1866
W. E. Everette, Tacoma, Wash.	Method of preserving wood.	801,859	Oct. 17, 1905
L. S. Fales, Monmouth Junction, N. J.	Improvement in compounds for preserving wood.	142,453	Sept. 2, 1873
H. W. Fawcett, Titusville, Pa., and Thomas Gowan, Meredith, Pa.	Improvement in preserving wood.	123,009	Jan. 23, 1872
J. S. George, Ferndale, Wash.	Injecting apparatus.	765,312	July 19, 1904
Jos. L. Ferrell, Philadelphia, Pa.	Method of and apparatus for fireproofing wood, etc.	620,114	Feb. 28, 1899
Jos. L. Ferrell, Philadelphia, Pa.	Process of impregnating wood.	694,956	March 11, 1902
Jos. L. Ferrell, Philadelphia, Pa.	Process of impregnating wood with fireproofing preservatives, etc.	695,450	March 18, 1902
Jos. L. Ferrell, Philadelphia, Pa.	Fireproofed wood and method of making same.	695,678	March 18, 1902

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Jos. L. Ferrell, Philadelphia Pa.	Fireproofing compound and method of making same.	695,679	March 18, 1902
Jos. L. Ferrell, Philadelphia, Pa.	Apparatus for impregnating wood.	716,400	Dec. 23, 1902
Jos. L. Ferrell, Philadelphia, Pa.	Apparatus for impregnating wood.	716,401	Dec. 23, 1902
Jos. L. Ferrell, Philadelphia, Pa.	Apparatus for impregnating wood.	727,928	May 12, 1903
Jos. L. Ferrell, Philadelphia, Pa.	Fireproofed wood, etc., and the art of making same.	728,452	May 19, 1903
Jos. L. Ferrell, Philadelphia, Pa.	Process of fireproofing wood.	767,514	Aug. 16, 1904
Lewis Feuchtwanger, New York, N. Y.	Improvement in preserving wood.	123,467	Feb. 6, 1872
J. W. Fielder, Princeton, N. J.	Improvement in apparatus for preserving wood by the Robbins process.	115,946	June 13, 1871
Henry Flad, St. Louis, Mo.	Method of seasoning wood.	231,783	Aug. 31, 1880
Henry Flad, St. Louis, Mo.	Process of preserving wood.	231,784	Aug. 31, 1880
Henry Flad, St. Louis, Mo.	Apparatus for the treatment of timber for preserving it.	253,361	Feb. 7, 1882
Webster Flockton, Bermondsey, England.	Improvement in metallic solution for the preservation of timber.	130	Feb. 16, 1837
H. P. Folsom and Howard Jones, Circleville, Ohio.	Sterilized erected pole.	837,820	Dec. 4, 1906
Henry Page Folsom and Howard Jones, Circleville, Ohio.	Sterilizing and preserving posts and poles.	894,619	July 28, 1908
B. S. Foreman, Morrison, Ill.	Improvement in preserving wood, railroad ties, etc.	43,191	June 21, 1864
B. S. Foreman.	Improvement in preserving wood, railroad ties, etc.	4,360	May 2, 1871
E. M. Fowler, New York, N. Y.	Improvement in preserving blocks of wood.	112,136	Feb. 28, 1871
J. D. Francks, Hannover, Germany.	Process of preserving wood.	231,419	Aug. 24, 1880
Chas. S. Friedman, Philadelphia, Pa.	Method of creosoting wood.	693,697	Feb. 18, 1902
Wm. T. Garratt, San Francisco, Cal., and S. J. Lynch, Santa Cruz, Cal.	Improvement in protecting wooden piles.	215,600	May 20, 1879
Jas. H. Gatling, Murfreesborough, N. C.	Improvement in treating the timber of old field pines.	113,158	March 28, 1871

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
J. W. Geibel, Loysburg, Pa.	Process of removing sap, etc., from wood.	825,819	July 10, 1906
Jos. F. Geisler, New York, N. Y.	Fireproofing and preserving wood.	560,614	May 19, 1896
Jos. F. Geisler, New York, N. Y.	Fireproofing and preserving wood.	675,826	June 4, 1901
Jos. F. Geisler, New York, N. Y.	Process of fireproofing wood.	679,739	Aug. 6, 1901
J. S. George, Newport, Ore.	Method of preserving timber.	533,587	Feb. 5, 1895
P. H. Gerhard, Austin, Tex.	Apparatus for treating timber.	794,605	July 11, 1905
John Knowles and Robert Gilbert, London, England.	Method of preserving timber and other vegetable products.	391	Sept. 21, 1837
C. C. and G. E. Gilman, Eldora, Iowa.	Fireproofing building materials.	560,580	May 19, 1896
J. T. Gilmer, Pensacola, Fla.	Sap and gum extractor.	858,380	July 2, 1907
J. L. Gilmore, Minneapolis, Minn.	Apparatus for creosoting the ends of poles.	797,275	Aug. 15, 1905
Edw. Gold, Vancouver, Can.	Method of protecting piles.	686,282	Nov. 12, 1901
A. J. Goodwin, New Smyrna, Fla.	Impregnating wood, etc., with copper.	414,111	Oct. 29, 1889
Geo. Wm. Gordon, Philadelphia, Pa.	Process of preserving wood.	751,981	Feb 9, 1904
Aug. Gotthilf, New York, N. Y.	Improvement in the method of protecting timber from destruction by worms, dry-rot or other processes of spontaneous decay.	232	June 14, 1837
Wm. D. Grimshaw, New York, N. Y.	Improvement in processes and apparatus for preserving and curing wood.	218,624	Aug. 19, 1879
Gustaf Grondal, Djursholm, Sweden.	Channel-furnace for treating wood.	245,162	Oct. 31, 1905
Hugo Gronwald, Berlin, Germany.	Process of preserving cork.	273,645	Sept. 11, 1906
Hugo Gronwald, Berlin, Germany.	Process of preserving cork.	830,831	Sept. 11, 1906
Tomaso Guissani, Milan, Italy.	Process of preserving wood.	707,224	Aug. 19, 1902
Tomaso Guissani, Milan, Italy.	Apparatus for impregnating.	713,630	Nov 13, 1902
Stuart Gwynn, New York, N. Y.	Improved process of saturating wood, cloth, paper, etc., with paraffine.	52,788	Feb. 20, 1866

List of United States Patents on Wood-Preservation (Continued.)

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Edwin Hagen, St. Louis, Mo.	Preserving wood.	246,762	Sept. 6, 1881
Francis Hall, Tacoma, Wash.	Method of preserving wood.	506,493	Oct. 10, 1893
Wm. A. Hall, New York, N. Y.	Art of coloring and fireproofing wood.	961,123	June 14, 1910
Alex. Hamar, Hungary, Austria.	Improvement in preserving wood from decay.	48,636	July 4, 1865
Alex. Hamar, Hungary, Austria.	Improvement in preserving timber.	51,528	Dec. 12, 1865
Louis Hanson, Wilmington, N. C.	Apparatus for preserving and creosoting wood.	722,505	March 10, 1903
Ludvig Hansen and Andrew Smith, Wilmington, N. C.	Apparatus for creosoting wood.	316,961	May 5, 1885
Ludvig Hansen and Andrew Smith, Wilmington, N. C.	Process for preserving wood.	317,129	May 5, 1885
Ludvig Hansen and Andrew Smith, Wilmington, N. C.	Wood-preserving apparatus.	322,819	July 21, 1885
Thos. Hanvey, Lancaster, N. Y.	Improvement in preparing and preserving wood.	62,956	March 19, 1867
Smith T. Harding, Morrison, Ill.	Improved compound for preserving wood.	68,069	Aug. 27, 1867
Louis Harmyer, Cincinnati, Ohio.	Improved composition for preserving wood, metal, canvas, etc.	73,246	Jan. 14, 1868
S. E. Haskin, Avoca, N. Y.	Method of vulcanizing wood.	399,196	March 5, 1889
S. E. Haskin, Avoca, N. Y.	Process of and apparatus for vulcanizing wood.	488,967	Dec. 12, 1892
Fritz Hasselmann, Rapfelburg, Germany.	Method of impregnating wood.	580,488	April 13, 1897
Fritz Hasselmann, Munich-Nymphenburg, Germany.	Method of impregnating wood.	626,538	June 6, 1899
Hermann Haupt, Philadelphia, Pa.	Improvement in drying, preserving and coloring wood or other fibrous material.	99,186	Jan. 25, 1870
Robert T. Haven, Wilmington, Ohio.	Improved process for preparing wood for boots and shoes.	54,339	May 1, 1866
Joshua R. Hayes, Washington, D. C.	Improvement in preserving wood.	107,904	Oct. 4, 1870
Ira Hayford, Boston, Mass.	Improvement in the process and apparatus for treating wood.	101,012	March 22, 1870
Ira Hayford, Boston, Mass.	Improvement in processes and apparatus for treating wood.	127,482	June 4, 1872

List of United States Patents on Wood-Preservation (Continued.)

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Ira Hayford, Boston, Mass.	Improvement in apparatus and processes for preserving wood.	194,773	Sept. 4, 1877
William Hayman, Taunton, Mass.	Improvement in composition for preserving wood.	110,652	Jan. 3, 1871
Theo. Wm. Heinemann, New York, N. Y.	Improved mode of purifying, seasoning and preserving wood.	76,757	April 14, 1868
Thos. Wm. Heinemann, New York, N. Y.	Improved method of seasoning and preserving wood.	94,204	Aug. 17, 1869
T. W. Heinemann, New York, N. Y.	Improved process and apparatus for preserving wood.	95,474	Oct. 5, 1869
Hubert Higgins, Cambridge, England.	Apparatus for impregnating and seasoning wood.	695,152	March 11, 1902
Arthur Holmes, Cortland, N. Y.	Improvement in preserving wood from decay.	62,334	Feb. 26, 1876
Ira Holmes, Moscow, N. Y.	Improvement in compounds for preserving wood.	124,358	March 5, 1872
H. L. Houghton, Morrison, Ill.	Improved composition for hardening and preserving wood.	65,674	June 11, 1867
Charles Howard, New York, N. Y.	Process of and apparatus for saturating wood.	557,271	March 31, 1896
Charles Howard, New York, N. Y.	Process for preserving wood.	899,400	Sept. 22, 1908
Wm. Howe, Seattle, Wash.	Pile-protector.	900,929	Oct. 13, 1908
Frank A. Howig, San Francisco, Cal.	Improvement in production of wooden bottle-stoppers and bungs.	197,220	Nov. 20, 1877
Pierre Hugon, Paris, France.	Improvement in apparatus for carbonizing wood.	48,882	July 18, 1865
D. W. Hunt, San Francisco, Cal.	Improved machine for kyanizing wood.	91,848	June 22, 1869
David W. Hunt, San Francisco, Cal.	Improvement in machines for kyanizing wood.	6,848	Jan. 11, 1876
John Huntington, Cleveland, Ohio.	Improvement in device for impregnating timber with antiseptic fluid.	171,135	Dec. 14, 1875
John Huntington, Cleveland, Ohio.	Improvement in device for impregnating timber with antiseptic fluid.	171,136	Dec. 14, 1875
Warren Iddings, Warren, O.	Preserving and hardening wood.	398,619	Feb. 26, 1889
B. A. Jaeger, Bower's Station, Pa.	Improved compound for preserving wood.	81,172	Aug. 18, 1868

List of United States Patents on Wood-Preservation (Continued.)

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Paul Jaeger, Esslingen, Germany.	Method of and apparatus for impregnating and dyeing wood.	578,516	March 9, 1897
B. H. Jenks, Bridesburg, Pa.	Improved process for coloring wood.	55,110	May 29, 1866
B. H. Jenks, Bridesburg, Pa.	Improved mode of treating wood for the manufacture of carding engines.	55,111	May 29, 1866
B. H. Jenks, Bridesburg, Pa.	Improved process of seasoning wood.	58,425	Oct. 2, 1866
Joseph Jones, New Orleans, La.	Improvement in preserving wood.	118,245	Aug. 18, 1871
Thos. Jones, Calstock, Eng.	Improvement in process of preserving wood.	155,191	Sept. 22, 1874
Wm. H. Jones, Rochester, N. Y.	Improvement in process of preserving wood.	132,584	Oct. 29, 1872
Chas. Karmrodt and Nicholas Thilmany, Bonn, Prussia.	Improvement in preserving wood.	132,584	March 30, 1869
Carl Kleinschmidt, Seattle, Wash.	Wood-preserving compound.	697,632	April 15, 1902
Ernst Koepfer, Vienna, Austria-Hungary.	Apparatus for impregnating wood.	910,546	Jan. 26, 1909
Franz L. Konrad, Munster, Germany.	Method of fireproofing wood.	629,861	Aug. 1, 1899
H. E. Kreuter, Dallas, Texas	Apparatus for treating timber, railway ties, etc.	249,953	Nov. 22, 1881
Rudolph Kroll, Spearfish, S. Dakota.	Wood-preservation by means of boring in timber to permit the entrance of air.	727,975	May 12, 1903
George Kron, Copenhagen, Denmark.	Method of producing liquid-tight joints for impregnating wood.	256,456	April 19, 1905
Berthold Kuckuck, Wannsee, near Berlin, Germany.	Apparatus for impregnating wood or other substances.	866,487	Sept. 17, 1907
John H. Kyan, Cheltonham, England.	Improved mode of preserving timber and other vegetable substances from decay.	800	June 23, 1838
Sylvester W. Labrot, New Orleans, La.	Process of preserving wood.	862,488	Aug. 6, 1907
Jas. Guy La Fonte, Indianapolis, Ind.	Improvement in treatment of wood for corset stays, etc.	201,022	March 5, 1878
Fred E. Lampert, San Francisco, Cal.	Coating for piles.	454,744	June 23, 1891
C. S. Lawrence, Plainfield, Wis.	Wood-preserving compound.	682,363	Sept. 10, 1901

List of United States Patents on Wood-Preservation (Continued.)

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Fred Lear, St. Louis, Mo.	Improvement in coloring and preserving wood.	109,027	Nov. 8, 1870
Fred Lear, St. Louis, Mo.	Improvement in preserving, coloring and seasoning wood.	116,969	July 11, 1871
Georg Friedrich Lebioda, Boulogne-sur-Seine, France.	Apparatus for dyeing and impregnating wood.	609,442	Aug. 23, 1898
Georg Friedrich Lebioda, Boulogne-sur-Seine, France.	Apparatus for impregnating wood.	644,252	Feb. 27, 1900
G. F. Lebioda, Boulogne-sur-Seine, France.	Apparatus for impregnating wood.	655,788	Aug. 14, 1900
G. F. Lebioda, Boulogne-sur-Seine, France.	Apparatus for impregnating wood.	689,317	Dec. 17, 1901
G. F. Lebioda, Boulogne-sur-Seine, France.	Process of obtaining impregnated wood.	729,362	May 26, 1903
Chas T. Lee, Boston, Mass.	Process of preserving wood.	419,858	Jan. 21, 1890
Louis L. Le Franc, Bosc-le-Hard, France.	Manufacture of wooden stoppers.	663,234	Dec. 4, 1900
Iens P. Lihme, Cleveland, Ohio.	Preserved wood and process of preparing same.	756,173	March 29, 1904
John T. Lloyd, New York, N. Y.	Vulcanizing wood.	566,591	Aug. 25, 1896
Fred A. Lobert, National City, Cal.	Compound for preserving timber.	546,960	Sept. 24, 1895
Rembrandt Lockwood, Brooklyn, N. Y.	Improvement in processes of treating wood.	174,914	March 21, 1876
John T. Logan, Texarkana, Texas.	Process of preserving wood.	831,793	Sept. 25, 1906
J. T. Logan, Texarkana, Tex.	Apparatus for treating the butt end of logs.	836,592	Nov. 20, 1906
John Loomis, Jeffersonville, Ind.	Solution for seasoning and preserving wood.	273,861	March 13, 1883
Ira Loughborough, Pittsford, N. Y.	Apparatus for saturating railroad ties.	533,543	Feb. 5, 1895
Cuthbert B. Lowry, Lexington, Ky.	Wood impregnation.	831,450	Sept. 18, 1906
Cuthbert B. Lowry, Lexington, Ky., and Richard Bernhard, Chicago, Ill.	Means for withdrawing and condensing vapor.	902,097	Oct. 27, 1908
M. A. Luckenbach, Denver, Col.	Process of treating wood to prevent decay.	473,705	April 26, 1892
Geo. A. Ludington, Akron, Ohio.	Method of vulcanizing ties in continuous lengths.	754,078	March 8, 1904

List of United States Patents on Wood-Preservation (Continued).

Inventor.	Title.	Number.	Date Issued.
Gregory Lukins, Sweetwater, Ill.	Preserving wood.	245,845	Aug. 16, 1881
Antionette Macauley, Fort Dodge, Iowa.	Wood-preserving compound.	778,321	Dec. 27, 1904
J. C. Mallonee, Charleston, S. C.	Process of preserving wood.	386,999	July 31, 1888
Ernest Marmetschke, Schopfurth, near Eberswalde, Germany.	Method of impregnating timber and the like.	898,246	Sept. 8, 1908
J. C. Marshall, Oakland, Cal.	Wood-preserving compound.	259,030	June 6, 1882
J. A. Mathieu, Detroit, Mich.	Apparatus for preserving railway ties.	332,097	Dec. 8, 1885
H. G. McGonegal, Washington, D. C.	Improvement in apparatus for preserving wood.	140,520	July 1, 1873
Jas. McKeon, Oakland, Cal.	Process of preserving timber.	461,365	Oct. 13, 1891
John McLachlan, Chicago, Ill.	Process of solidifying wood.	575,973	Jan. 26, 1897
A. R. McNair, New York, N. Y.	Improvement in preserving wood from decay and mildew.	94,626	Sept. 7, 1869
Wm. K. Miller, Canton, Ohio	Improvement in burial cases.	57,545	Aug. 28, 1866
E. P. Morong, Boston, Mass.	Improvement in preserving wooden pavement.	134,479	Dec. 31, 1872
L. D. Mott, Marshalltown, Iowa.	Compound for preserving wood and metal.	251,918	Jan. 3, 1882
H. G. Muller, San Francisco, Cal.	Preserved wood.	236,065	Dec. 28, 1880
Peter Murray, Seattle, Wash.	Method of preserving timber.	495,991	April 25, 1893
H. C. Myers, Cleveland, O.	Method of vulcanizing wood.	537,393	April 9, 1895
Robt. Newell, Philadelphia, Pa.	Improvement in compound for coating wood and other articles to render them acid-proof.	140,530	June 21, 1873
B. R. Nickerson, San Francisco, Cal.	Improvement in preserving and hardening wood.	107,620	Sept. 20. 1870
William C. Jones, W. J. R. Stratford, F. B. Byrnes and E. J. Nixon, Texarkana, Texas.	Process of saturating wood.	216,286	Nov. 7, 1905
Patrick O'Brien, South Bend, Ind.	Improvement in processes for preparing the surface of woodwork for carriages.	175,621	April 4, 1876
John Oliver, Toronto, Can.	Improvement in preserving and drying lumber.	142,347	Sept. 2, 1873

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Geo. Palmer, Littlestown, Pa.	Improvement in preserving wood.	49,146	Aug. 1, 1865
Chas. W. Parker, Genesee Fork, Pa.	Preserving posts, etc.	378,459	Feb. 28, 1888
William D. Patten, New York, N. Y.	Fireproofing compound.	802,311	Oct. 17, 1905
Jos. Paul and Ira Hayford, Boston, Mass.	Improved process of treating wood to preserve, season and give it a better surface.	95,583	Oct. 5, 1869
Chas. Payne, South Lambeth, England.	Improvement in processes for preserving wood.	7,399	May 28, 1850
Wm. T. Pelton, New York, N. Y.	Improvement in portable apparatus for preserving wood.	113,338	April 4, 1871
Wm. T. Pelton, New York, N. Y.	Improvement in apparatus for seasoning and preserving wood.	124,080	Feb. 27, 1872
Herbert E. Percival, Houston, Texas.	Wood-preserving compound.	891,726	June 23, 1908
Samuel R. Perry, New York, N. Y.	Preserving wood.	249,856	Nov. 22, 1881
Josef Pfisten, Vienna, Austria-Hungary.	Method of preserving timber.	683,792	Oct. 1, 1901
Josef Pfisten, Vienna, Austria-Hungary.	Process of staining wood.	708,069	Sept. 2, 1903
Josef Pfisten, Vienna, Austria-Hungary.	Apparatus for impregnating or staining wood.	735,019	July 28, 1903
Geo. Phillips, Key West, Fla.	Coating for wooden structures.	414,247	Nov. 5, 1889
Geo. Phillips, Key West, Fla.	Process of preserving wood.	414,249	Nov. 5, 1889
A. M. Pierce, Brooklyn, N. Y.	Process of fireproofing wood.	737,468	Aug. 25, 1903
Wm. Powell, Liverpool, Eng.	Vulcanized wood and process of vulcanizing same.	755,240	March 22, 1904
Theo. Pridham, Petersham, New South Wales.	Coating timber.	453,821	June 9, 1891
D. R. Prindle, East Bethany, N. Y.	Improved process of preserving wood and timber.	63,300	March 26, 1867
Thos. N. Prudden, San Francisco, Cal.	Method and apparatus for protecting marine wooden structures.	855,588	June 4, 1907
A. D. Pruinton, Dover, N. H.	Improved composition for setting posts, timbers, etc.	78,691	June 9, 1868

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Geo. Pustkuchen, Hoboken, N. J.	Improved apparatus for impregnating wood with tar and other materials.	64,703	May 14, 1867
Jos. W. Putman, New Orleans, La.	Apparatus for treating wood for preserving it.	247,947	Oct. 4, 1881
Jos. W. Putman, New Orleans, La.	Apparatus for treating timber with antiseptics.	266,516	Oct. 24, 1882
Jos. W. Putman, New Orleans, La.	Compound for preserving timber.	404,302	May 28, 1889
Jos. W. Putman, New Orleans, La.	Wood-preserving compound.	405,907	June 25, 1889
Randolph E. Radebaugh, Tacoma, Wash.	Process and apparatus for treating wooden stopples.	535,770	March 12, 1895
Frederick Ransome, Ipswich, Great Britain.	Improvement in preserving timber.	55,216	May 29, 1866
John M. Reid, Allegheny, Pa.	Improvement in preserving wood.	154,767	Sept. 8, 1874
Peter C. Reilly, Indianapolis, Ind.	Preserved wood and method of making same.	901,557	Oct. 20, 1908
Peter C. Reilly, Indianapolis, Ind.	Preserving wood.	899,904 899,905	Sept. 29, 1908
R. P. Reynolds, Walla Walla, Wash.	Timber preservative.	792,458	July 13, 1905
H. L. Ricks, Eureka, Cal.	Method of preserving submerged timbers.	380,820	April 10, 1885
Samuel Ringold and Edw. Earle, Savannah, Ga.	Improved mode of preserving timber by boiling the same in limewater.	877	Aug. 6, 1838
L. S. Robbins, New York, N. Y.	Improved process of preserving wood.	47,132	April 4, 1865
L. S. Robbins, New York, N. Y.	Improvement in processes for preserving wood.	165,768	July 20, 1875
L. S. Robbins, New York, N. Y.	Improved mode of preserving wood.	89,345	April 27, 1869
L. S. Robbins, Elizabeth, N. Y.	Improvement in processes and apparatus for preserving wood or lumber.	217,022	July 1, 1879
L. S. Robbins, New York, N. Y.	Preserving wood.	9,512	Dec. 21, 1880
J. G. Robinson, Brooklyn, Ala.	Fence post.	655,638	Aug. 7, 1900
W. W. Robinson, Ripon, Wis.	Process of preserving wood.	294,676	March 4, 1884
H. N. Roge, Edouard Poret, Pierre Baffoy and Pierre Dupre, Paris, France.	Improvement in processes of preserving wood and other vegetable matters.	191,257	May 29, 1877

List of United States Patents on Wood-Preservation (Continued.)

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
James Rowe, San Francisco, Cal.	Composition for protecting piles.	440,832	Nov. 18, 1890
Samuel M. Rowe, Chicago, Ill.	Door mechanism for creosoting tanks.	908,144	Dec. 29, 1908
Karl Ricker, Zernsdorf, Germany.	Method of fireproofing wood.	691,812	Jan. 28, 1902
Max Rueping, Charlottenburg, Germany.	Method of impregnating wood.	707,799	Sept. 23, 1902
Julius Rutgers, Berlin, Germany.	Wood-impregnating compound and method of making same.	662,310	Nov. 20, 1900
Emile Sabathe and Louis Jourdan, Paris, France.	Improvement in impregnating substances with preservative material.	58,036	Sept. 11, 1866
Thos. H. Sampson, New Orleans, La.	Process of preserving lumber.	403,144	May 14, 1889
J. J. Samuels, San Francisco, Cal.	Improved composition for preparing and hardening wood and preserving the same.	60,794	Jan. 1, 1867
Chr. Schallberger, San Francisco, Cal.	Compound for protecting timber.	678,201	July 9, 1901
Chr. Schallberger, San Francisco, Cal.	Wood-preserving compound.	714,521	Nov. 25, 1902
Julius Schenkel, Dortmund, Germany.	Process of impregnating wood.	655,459	Aug. 7, 1900
Julius Schenkel, Dortmund, Germany.	Process of fireproofing wood.	647,428	April 10, 1900
P. Schmidt.	Preserving wood.	4,560	June 6, 1846
Jos. Schneible, New York, N. Y.	Method of and apparatus for saturating corks.	599,798	March 1, 1898
Charles A. Seely, New York, N. Y.	Improved method of impregnating wood with oleaginous and saline matters.	69,260	Sept. 24, 1867
Jos. A. Sewall, Denver, Col.	Process of preserving wood.	374,208	Dec. 6, 1887
A. J. Sheldon, Buffalo, N. Y.	Improvement in preserving wood.	106,625	Aug. 23, 1870
Morris Sherman, Chattanooga, Tenn.	Means for securing heads to boilers, cylinders, etc.	781,371	Jan. 31, 1905
S. L. Shuffleton, Seattle, Wash.	Method of protecting wooden piles.	676,704	June 18, 1901
J. E. Siebel, Chicago, Ill.	Improvement in depilating hides and preserving wood.	116,638	July 4, 1871
H. V. Simpson, London, Eng.	Fireproofing wood.	646,101	March 27, 1900

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
H. V. Simpson, London, Eng.	Process of fireproofing wood.	668,227	Feb. 19, 1901
Archibald J. Sinclair, Chicago, Ill.	Process of coating porous material with asphalt.	893,391	July 14, 1908
Smith A. Skinner, Hoosick Falls, N. Y.	Cordage and twine to be used in binding sheaves of grain.	255,040	March 14, 1882
Bat Smith, Spanish Camp, Texas.	Composition for preserving wood.	244,327	July 12, 1881
Geo. B. Smith, Philadelphia, Pr.	Improvement in apparatus for preserving wood.	160,846	March 16, 1875
Geo. B. Smith, Philadelphia, Pr.	Improvement in wooden shingles made fireproof.	199,001	Jan. 8, 1878
W. B. Smith, Lafayette, Ill.	Improved apparatus for saturating timber.	62,295	Feb. 19, 1867
W. H. Smith, Steubenville, Ohio.	Improvement in apparatus for injecting preservative liquids into wood.	111,784	Feb. 14, 1871
W. L. Smith, New York, N. Y.	Apparatus for impregnating wood.	711,080	Oct. 14, 1902
P. S. Smout, Everett, Wash.	Composition for preserving piles and timber.	806,591	Dec. 5, 1905
Edw. Spaulding, Brooklyn, N. Y.	Improved process for treating wood.	77,777	May 12, 1868
S. F. Spaulding, Jerico, Conn.	Improvement in preparing veneers for butter boxes.	164,945	June 29, 1875
Geo. Speis, Dutch Kills, N.Y.	Preserving wood.	387,375	Aug. 7, 1888
Chas. F. Spicker, New York, N. Y.	Improvement in coloring and hardening wood.	3,635	June 24, 1844
I. B. Sprague, Everett, Wash.	Process of preserving wood.	694,212	Feb. 25, 1902
Jas. D. Stanley, Eastover, S. C.	Device for charring surface of timber.	361,095	April 12, 1887
Jas. D. Stanley, Wilmington, S. C.	Apparatus for charring timber.	282,395	July 31, 1883
Jas. D. Stanley, Eastover, S. C.	Device for charring logs.	361,193	April 12, 1887
Chas. W. Stanton, Mobile, Ala.	Apparatus for steaming wood.	735,608	Aug. 4, 1903
Adolph Ste. Marie and Alfre Hoffman, Lyons, France.	Process of seasoning wood.	675,500	June 4, 1901
Jas. C. Stead, Jersey City, N. J.	Improvement in apparatus for preserving wood.	148,630	March 17, 1874
L. M. Stern and Edw. M. Kempner, Buffalo, N. Y.	Apparatus for impregnating wood.	662,104	Nov. 20, 1900

List of United States Patents on Wood-Preservation (Continued).

Inventor.	Title.	Number.	Date Issued.
F. A. Stevens, Chicago, Ill.	Improvement in apparatus for preserving wood.	102,725	May 3, 1870
Chas. Stollberg, Toledo, Ohio	Sheet-metal sap receptacle or vessel.	857,846	June 25, 1907
Richard Sutphens, Freehold, N. J.	Improvement in wood-preserving compositions.	120,009	Oct. 17, 1871
Geo. W. Swan, San Francisco, Cal.	Improvement in the processes for softening and toughening blocks of wood.	142,298	Aug. 26, 1873
Wm. Taggart, San Francisco, Cal.	Preserving piles.	261,045	July 18, 1882
A. H. Tait, Jersey City, N. J.	Improvement in preserving wood.	115,784	June 6, 1871
Rudolf Tanczos, Vienna, Austria-Hungary.	Fireproofing wood.	329,973	Nov. 10, 1885
Charles Taylor, R. I. Murchison and George Sharp, Melbourne, Victoria.	Composition for preserving timber.	391,209	Oct. 16, 1888
J. H. Taylor, New York, N. Y.	Improved process of preventing decay in wood.	70,761	Nov. 12, 1867
Wm. B. Taylor, Winterpark, Fla.	Composition for preserving wood.	759,938	May 17, 1904
L. N. Teachman, Lincoln, Neb.	Wood-preserving composition.	277,810	May 15, 1883
Horace Thayer, Warsaw, N. Y.	Treating wood for the manufacture of boxes, cases, etc.	45,537	Dec. 20, 1864
Waldemar Thilmany, Cleveland, Ohio.	Improvement in apparatus for impregnating timber with antiseptics.	177,770	May 23, 1876
Waldemar Thilmany, Cleveland, Ohio.	Improvement in processes for preserving timber.	202,678	April 23, 1878
Nathan H. Thomas, New Orleans, La.	Improvement in processes for preserving wood.	113,706	April 11, 1871
A. B. Tripler, New Orleans, La.	Improvement in preserving wood.	104,916	June 28, 1870
A. B. Tripler, New Orleans, La.	Improvement in preserving wood for railroad ties, etc.	104,917	June 28, 1870
A. B. Tripler, Philadelphia, Pa.	Improvement in processes for preserving wooden pavements from rot.	126,592	May 7, 1872
A. B. Tripler, New York, N. Y.	Improvement in processes for staining wood.	207,630	Sept. 3, 1878
A. B. Tripler, New York, N. Y.	Improvement in the art of preserving wood.	208,649	Oct. 1, 1878

List of United States Patents on Wood-Preservation (Continued).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Abel D. Tyler, Worcester, Mass.	Impregnating wood.	553,547	Jan. 28, 1896
Geo. S. Valentine, Brooklyn, N. Y.	Process of and apparatus for preesrving wood by impregnation to given heights.	285,087	Sept. 18, 1883
Rose L. Valleen, Seattle, Wash.	Wood-preserving compound.	579,101	March 16, 1897
G. A. Vivien and Paul C. Vivien.	Improvement in composition for preserving wood, coating ships' bottoms, etc.	123,801	(?)
J. G. Voorhees, Aqueduct Mills, N. J.	Improvement in preserving wood.	121,141	Nov. 21, 1871
Martin Voorhees, Princeton, and W. N. Custis, Camden, N. J.	Improved process and apparatus for seasoning and impregnating wood with preservative material.	87,226	Feb. 23, 1869
John F. Walter, Jr., Brooklyn, N. Y.	Process of drying and seasoning lumber.	287,351	Oct. 23, 1883
Fred J. Warren, Newton, Mass.	Wooden block pavement.	794,758	July 18, 1905
Chas. G. Waterbury, New York, N. Y.	Improvement in processes for hardening and preserving wood.	124,402	March 5, 1872
Ezra Webb, New York, N. Y.	Improvement in preserving wood.	108,659	Oct. 25, 1870
Peter Welch, St. Louis, Mo.	Improvement in preserving wood.	129,503	July 16, 1872
William Wellhouse and Erwin Hagen, St. Louis, Mo.	Improvement in preserving wood.	216,589	June 17, 1879
Pelag Werni, Philadelphia, Pa.	Improvement in compounds for preserving wood.	164,786	June 22, 1875
S. P. Wheeler, Bridgeport, Conn.	Improvement in the manufacture of articles of compressed wood.	101,552	April 5, 1870
S. P. Wheeler, Bridgeport, Conn.	Improved process of treating wood.	101,553	April 5, 1870
Thos. B. White, Warsaw, Mo.	Post protector.	868,953	Oct. 22, 1907
Sidney S. Williams, Providence, R. I.	Apparatus for use in treating wood.	904,589	Nov. 24, 1908
Sigmund Willner, London, England.	Apparatus for impregnating wood.	620,627	March 7, 1899
Sigmund Willner, London, England.	Apparatus for impregnating wood.	676,060	June 11, 1901
Sigmund Willner, London, England.	Apparatus for impregnating wood.	771,689	Oct. 4, 1904

List of United States Patents on Wood-Preservation (Concluded).

INVENTOR.	TITLE.	NUMBER.	DATE ISSUED.
Sigmund Willner, Memphis, Tenn.	Apparatus for forcing fluids into wood.	807,411	Dec. 12, 1905
Sigmund Willner, Chicago, Ill.	Apparatus for injecting chemicals into logs.	896,785	Aug. 22, 1908
Jas. P. Witherow, Pittsburgh, Pa.	Process of and apparatus for vulcanizing wood.	446,501	Feb. 17, 1891
Jas. P. Witherow, Pittsburgh, Pa.	Apparatus for vulcanizing wood.	446,500	Feb. 17, 1891
Jas. H. Young, New York, N. Y.	Apparatus for impregnating wood.	329,799	Nov. 3, 1885
Wm. Youngblood, Jamaica, N. Y.	Method of preserving wood.	398,366	Feb. 19, 1889

IMBER IN THE UNITED STATES.

Date of Last Inspection. 10	Final Condition of Material at Last Inspection. 11	Cause of Removals. 12	
1914	All out in 1896	——	Gave 14 years a
1914	7.7% removed	Decay	
1914	31 % "	——	
"	26 % "	——	
"	1.3% "	Decay	1 Red Gum Tie
1914	99.6% "	——	20% were out b
1914	None removed	——	
1914	4 % removed	Decay	
1914	0.3% "	Split	3% split, 2% sh
"	0.4% "	Decay	not consider process).
1914	7.5% "	"	2 Red Gum and
"	One Tie out in 1914	——	Slightly rail cut
"	" " "	——	" "
"	None out	——	
"	"	——	
"	——	——	No record of fai
"	——	——	" "
1895	100% out	Rail Cut	10% removed ir
1908	——	"	Average life 15.
1914	All out in 1912	None Decayed All Rail Cut	Laid in a funne
1906	92.5% removed	——	Average life 19
1910	40 % "	Rail Cut Very Few Decayed	Remainder in gc
1914	20.9% "	Decay	
"	——	"	9 years averag
"	——	"	9.5 " "
"	——	"	8.0 " "
"	——	"	6.4 " "
"	——	"	4.0 " "
"	——	Decayed and Crushed	9.0 " "
1908	Splintered	——	Average life 10
1849	——	——	Sound after 11
1914	——	Decay	9.5 years averag
"	——	Rot Where Covered by Dirt 97 per cent. of Removals Due to Decay	"
——	——		Given 7 to 9 ye
1914	55% out	Decay	7 to 8 years a
"	68% "	"	6 " 7 "
"	All out	"	11.34 "
"	"	"	10.97 "

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RECORDS ON THE LIFE OF TREATED TIMBER IN THE UNITED STATES.

By Howard F. Weiss and Clyde H. Teesdale.

Acknowledgments are due to our American railroads, treating plants, city engineers and others for their valuable assistance in furnishing much of the data upon which the durability tests given in this table are based. Some of the data were also taken from an unpublished table compiled by C. P. Winslow. The Proceedings of the American Railway Engineering Association and the American Wood Preservers' Association have been freely used.

Definite data on the life of timber in service is of prime importance to the wood-preserving industry and especially to those interested in developing the various methods of treating timber. While great quantities of timber have been treated, practical data upon which reliable annual costs can be figured are incomplete. In early years railroad companies and other consumers kept few records of their treated timber. Recently many test tracks have been installed, on which very complete records are being kept, but these, in most cases, are still too recent to furnish durability data of much value.

In this table are given the most reliable durability records that we have been able to obtain. As far as possible, only definite and accurate records on timber located in the United States have been included.

A very large number of requests for durability records were sent to companies controlling patented processes and some proprietary preservatives and also to railroad engineers and other consumers of treated timber.

In the case of some processes and preservatives it is noted that no records are given. With some of the patented processes the oldest records are less than 10 years old, and in order to give some data on them the best records have been included. In order to reduce the size of the table, only the most reliable records on the Burnett, Wellhouse and full-cell processes have been included. Furthermore, so far as possible, recent records on treated timber still in service have been eliminated.

In view of the laxity with which treated timber has been handled and used, very few records contain information in sufficient detail, and because of this their usefulness is greatly curtailed. The authors assume no responsibility whatever for the accuracy of any of the records given in the table, except those for which the Forest Service is the authority. No cost data accompany the records, as these could not be obtained. There are doubtless many excellent records on the durability of treated timber that have not been included. The authors would greatly appreciate having additional records called to their attention.

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PRESERVATIVE.	FORM.	PROCESS.	SPECIES.	RECORD NUMBER.
Carbolineum-avenarius	Mine Timbers	Open Tank	Beech	114
"	"	"	Hemlock	115-116-117
"	"	"	Maple	118
"	"	"	Pine, Loblolly	119-120-121
"	Poles	Brush	Cedar, W. Red	134
"	"	"	" S. White	139
"	"	"	Chestnut	137-138-140-141
"	"	"	Pine, W. Yellow	135-136
Carbolineum-S. P. F.	"	"	Cedar, S. White	164-165
"	"	"	Chestnut	162-163-166-167
Copper Sulphate	Ties	Thilmany	Pine, White	2
Creolin	Poles	Brush	Cedar, S. White	144
"	"	"	Chestnut	142-143
Creosote	Ties	"	Oak, White	26-27-28
"	"	Full Cell	Fir, Douglas	3
"	"	"	Gum, Red	4
"	"	"	Gum, Tupelo	5
"	"	"	Oak, Red and Gum, Red	6
"	"	"	Pine	7-8
"	"	Giussani	Oak, Red and Gum, Red	2-5
"	"	Lowry	——	9
"	"	Not Given	Cypress and Cedar	20
"	"	"	Hemlock	21-22
"	"	"	Pine	23
"	"	"	Pine, Longleaf	24
"	"	Pressure	Oak, Red and Gum, Red	10
"	"	Rueping	Gum, Red	11
"	"	"	Oak, Red	12
"	"	"	Oak, Red and Gum, Red	13
"	"	"	Pine, Loblolly	14-15
"	"	"	Pine	16-17
"	"	"	Not Given	18-19
"	Piling	Boiling	Fir, Douglas	81-82
"	"	Full Cell	" "	83

PRESERVATIVE.	FORM.	PROCESS.	SPECIES.	RECORD NUMBER.
Creosote	Piling	Full Cell	Oak, White	84
"	"	"	Pine, S. Yellow	85 to 100 Incl.
"	"	"	Pine, Sap	101
"	"	"	Not Given	102 to 108 Incl.
"	Bridge Stringers	Boiling	Fir, Douglas	109
"	" Timbers	Full Cell	Pine, Longleaf	110-111
"	" "	"	" S. Yellow	112-113
"	Mine "	"	Fir, Red	122-123
"	"	Open Tank	Hemlock	120-124-126-127
"	"	"	Pine, Loblolly	128-129-130
"	"	"	Pine	131-132
"	"	"	Pine, Loblolly & Shortleaf	133-133A-133B
"	"	Full Cell	"	123A
"	Poles	Brush	Chestnut	150-152-153
"	"	"	Cedar, S. White	151-154
"	"	"	" W. Red	156
"	"	"	Pine, W. Yellow	155
"	"	Open Tank	Cedar, W. Red	148
"	"	"	Chestnut	145-146
"	"	"	Pine, W. Yellow	147-149
"	"	Full Cell	" S. Yellow	157-157A
"	Posts	Open Tank	Basswood	178
"	"	"	Bay	179
"	"	"	Cedar, White	180
"	"	"	Cypress	181
"	"	"	Gum, Sweet	182
"	"	"	" Tupelo	183
"	"	"	Oak, Red	184-185
"	"	"	" Post	186
"	"	"	Pine, Loblolly	187-188
"	"	"	" S. Yellow	189
"	"	"	" Oldfield	190
"	"	"	Walnut, Black	191
"	"	"	Willow	192
"	Paving Blocks	Dipping	Fir, Douglas	193-194
"	"	Full Cell	Pine, Longleaf	195 to 199 Incl.

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PART I—PRESERVATIVE (Continued).

PRESERVATIVE.	FORM.	PROCESS.	SPECIES.	RECORD NUMBER.
Creosote	Paving Blocks	Full Cell	Pine, Norway	203
"	"	"	Pine, Norway, Tamarack and Hemlock	200-201
"	"	"	Pine, Norway & Longleaf; Fir, Douglas; Larch, West; Birch, White; Tamarack, Hemlock	202
"	"	"	Pine and Tamarack	204
"	Elec. Conduit	"	Pine, Longleaf	233
"	—	Am. Creosote Wks.	—	1
Creosote, water-gas-tar	Miscellaneous	Open Tank	Pine S. Yellow	234
" " " "	Mine Timbers	"	" Loblolly & Shortleaf	133C-133D
Cresote, wood tar	Poles	Brush	Chestnut	173-174
" " "	Ties	Dipping	Oak, White	30
" " "	"	"	" Red	29
Creosote and resin	"	Creo-Resinate	Pine, S. Yellow	31
" " "	Paving Blocks	"	" Longleaf	206-207-208 209-210-222
Crude oil	Poles	Open Tank	Cedar, W. Red	159
"	"	"	Pine, W. Yellow	158
Imper. wood preserver	"	Brush	Cedar, S. White	161
" " "	"	"	Chestnut	160
Kreodone	Paving Blocks	Full Cell	Pine, Longleaf	211-212-213
"	"	"	Pine, Norway Tamarack & Hemlock	214-215
Mercuric Chloride	Ties	Kyan	Hemlock	32
" "	"	"	Chestnut & Oak	33
Spirittine	Poles	Brush	Cedar, S. White	168
"	"	"	Chestnut	169
Tar Coating	"	"	"	170-171-172
Zinc Chloride	Ties	Burnett	Fir, Douglas	34 to 42 Incl.
" "	"	"	Gum, Red	43
" "	"	"	" Tupelo	44
" "	"	"	Hemlock	45-46-47
" "	"	"	Oak, Red	48-49
" "	"	"	Pine, Black Hills	50
" "	"	"	" Longleaf	51

PRESERVATIVE.	FORM.	PROCESS.	SPECIES.	RECORD NUMBER.
Zinc Chloride	Ties	Burnett	Pine	52
" "	"	"	Pine, Sap	53
" "	"	"	Pine & Fir, Douglas	54
" "	"	"	Tamarack	55-56
" "	"	"	Oak, Red; Elm, Ash, Beech	57
" "	Mine Timbers	"	Pine, Loblolly and Shortleaf	133G
" "	Poles	Open Tank	Cedar, W. Red	175
" "	"	"	Pine, W. Yellow	176
Zinc Chloride and Creosote	——	Allardyce	——	57A
" " " "	Ties	Card	Not Given	64-64A
" " " "	"	Zinc-Creosote	Gum, Red	58
" " " "	"	"	" Tupelo	59
" " " "	"	"	Oak, Red	60
" " " "	"	"	Pine	61-62-66
" " " "	"	"	Pine, Sap	63
" " " "	"	"	Pine and Hemlock	65
" " " "	Poles	Open Tank	Cedar, W. Red	177
Zinc Tannin	Ties	Wellhouse	Gum	67
" "	"	"	Hemlock	68 to 73 Incl.
" "	"	"	Oak, Red	74
" "	"	"	Pine,	75
" "	"	"	Pine, Sap	76
" "	"	"	" Shortleaf	77
" "	"	"	Tamarack	78-79
" "	"	"	Pine, White & Norway and Tamarack	80
Not stated	Paving Blocks	Not Stated	Cedar, Wash.	216
"	"	"	Pine, Longleaf	217 to 221 Incl.
				223 to 229 Incl.
"	"	"	Fir, Douglas	230
"	"	"	Pine, Longleaf and Gum, Black	231
"	"	"	Pine, Norway & Tamarack	232

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PART II—PROCESS.

PROCESS.	FORM.	PRESERVATIVE.	SPECIES.	RECORD NUMBER.
Am. Creosote Works	——	Creosote	——	1
Allardyce	——	Zinc Chloride & Creosote	——	57A
Boiling	Piling	Creosote	Fir, Douglas	81-82
"	Bridge Stringers	"	" "	109
Burnett	Ties	Zinc Chloride	" "	34 to 42 Incl.
"	"	"	Gum, Red	43
"	"	"	" Tupelo	44
"	"	"	Hemlock	45-46-47
"	"	"	Oak, Red	48-49
"	"	"	Pine, Black Hills	50
"	"	"	" Longleaf	51
"	"	"	Pine	52
"	"	"	" Sap	53
"	"	"	" and Fir, Douglas	54
"	"	"	Tamarack	55-56
"	"	"	Oak, Red-Elm-Ash-Beech	57
Brush	"	Creosote	Oak, White	26-27-28
"	Poles	"	Chestnut	150-152-153
"	"	"	Cedar, S. White	151-154
"	"	"	" W. Red	156
"	"	"	Pine, W. Yellow	155
"	"	Creosote, Wood-Tar	Chestnut	173-174
"	"	Carbolineum. Avenarius	Cedar, W. Red	134
"	"	"	" S. White	139
"	"	"	Chestnut	137-138-140-141
"	"	"	Pine, W. Yellow	135-136
"	"	Carbolineum, S. P. F.	Cedar, S. White	164-165
"	"	"	Chestnut	162-163-166-167
"	"	Creolin	Cedar, S. White	144
"	"	"	Chestnut	142-143
"	"	Imper. Wood Preser.	Cedar, S. White	161
"	"	"	Chestnut	160
"	"	Spirittine	Cedar, S. White	168
"	"	"	Chestnut	169

PROCESS.	FORM.	PRESERVATIVE.	SPECIES.	RECORD NUMBER.
Brush	Poles	Tar Coating	Chestnut	170-171-172
Card	Ties	Zinc-Creosote	Not Given	64-64A
Creo-Resinate	"	Creosote & Resin	Pine, S. Yellow	31
"	Paving Blocks	"	" Longleaf	206-207-208 209-210-222
Dipping	Ties	Creosote, Wood-Tar	Oak, White	30
"	"	"	" Red	29
"	Paving Blocks	Creosote, Coal-Tar	Fir, Douglas	193-194
Full Cell	Ties	"	" "	3
"	"	"	Gum, Red	4
"	"	"	" Tupelo	5
"	"	"	Oak, Red & Gum, Red	6
"	"	"	Pine	7-8
"	Piling	"	Fir, Douglas	83
"	"	"	Oak, White	84
"	"	"	Pine, S. Yellow	85 to 100 Incl.
"	"	"	" Sap	101
"	"	"	Not Given	102 to 108 Incl.
"	Bridge Timbers	"	Pine, Longleaf	110-111
"	"	"	" S. Yellow	112-113
"	Mine Timbers	"	Fir, Red	122-123
"	Paving Blocks	"	Pine, Longleaf	195 to 199 Incl.
"	"	"	" Norway	203
"	"	"	Tamarack	205
"	"	"	Pine, Norway; Tamarack, Hemlock	200-201
"	"	"	Pine, Norway & Longleaf; West Larch; Fir, Douglas; Hemlock and Tamarack	202
"	"	"	Pine and Tamarack	204
"	"	Kreodone	Pine, Longleaf	211
"	"	"	Pine, Norway; Tamarack, Hemlock	214-215
"	Elec. Conduit	Creosote	Pine, Longleaf	233
"	Poles	"	" S. Yellow	157-157A
Giussani	Ties	"	Oak, Red & Gum, Red	25
Kyan	"	Mercuric Chloride	Hemlock	32

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PART II—PROCESS (Continued).

Process.	Form.	Preservative.	Species.	Record Number.
Kyan	Ties	Mercuric Chloride	Chestnut & Oak	33
Lowry	"	Creosote	——	9
Not Given	"	"	Cypress & Cedar	20
"	"	"	Hemlock	21-22
"	"	"	Pine	23
"	"	"	" Longleaf	24
Open Tank	Mine Timbers	"	Hemlock	120-124-126-127
"	"	"	Pine, Loblolly	128-129-130
"	"	"	Pine	131-132
"	"	"	Pine, Loblolly & Shortleaf	133
"	"	Carbolineum, Avenarius	Beech	114
"	"	"	Hemlock	115-116-117
"	"	"	Maple	118
"	"	"	Pine, Loblolly	119-120-121
"	"	Zinc Chloride	" " & Shortleaf	133E-133F
"	Poles	Creosote	Cedar, W. Red	148
"	"	"	Chestnut	145-146
"	"	"	Pine, W. Yellow	147-149
"	"	Crude Oil	Cedar, W. Red	159
"	"	"	Pine, W. Yellow	158
"	"	Zinc Chloride & Creosote	Cedar, W. Red	177
"	"	Zinc Chloride	" " "	175
"	"	"	Pine, W. Yellow	176
"	Posts	Creosote	Basswood	178
"	"	"	Bay	179
"	"	"	Cedar, White	180
"	"	"	Cypress	181
"	"	"	Gum, Sweet	182
"	"	"	" Tupelo	183
"	"	"	Oak, Red	184-185
"	"	"	" Post	186
"	"	"	Pine, Loblolly	187-188
"	"	"	" S. Yellow	189
"	"	"	" Oldfield	190
"	"	"	Walnut, Black	191
"	"	"	Willow	192

PROCESS.	FORM.	PRESERVATIVE.	SPECIES.	RECORD NUMBER.
Open Tank	Miscellaneous	Creos. Water-Gas-Tar	Pine, S. Yellow	234
Pressure	Ties	Creosote, Coal-Tar	Oak, Red & Gum, Red	10
Rueping	"	"	Gum, Red	11
"	"	"	Oak, Red	12
"	"	"	" & Gum, Red	13
"	"	"	Pine, Loblolly	14-15
"	"	"	Pine	16-17
"	"	"	Not Given	18-19
Thimany	"	Copper Sulphate	Pine, White	2
Wellhouse	"	Zinc Tannin	Gum	67
"	"	"	Hemlock	68 to 73 Incl.
"	"	"	Oak, Red	74
"	"	"	Pine	75
"	"	"	" Sap	76
"	"	"	" Shortleaf	77
"	"	"	Tamarack	78-79
"	"	"	Pine (White & Norway) and Tamarack	80
Zinc-Creosote	"	Zinc Chloride & Creos.	Gum, Red	58
"	"	"	" Tupelo	59
"	"	"	Oak, Red	60
"	"	"	Pine	61-62-66
"	"	"	" Sap	63
"	"	"	Pine & Hemlock	65
Not Stated	Paving Blocks	Not Stated	Cedar, Wash.	216
"	"	"	Pine, Longleaf	217 to 221 Incl. & 223 to 229 Incl.
"	"	"	Fir, Douglas	230
"	"	"	Pine, Longleaf & Gum, Black	231
"	"	"	Pine, Norway; Tamarack	232

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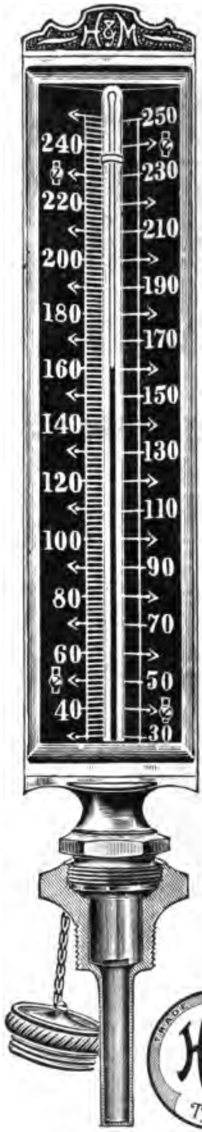

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